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EDITORIAL

SOIL IMPROVEMENT ON RUBBER ESTATES

IN view of the interest being taken in the various problems connected with soil improvement on rubber estates, the attention of all rubber planters is directed to two papers by men who are closely in touch with modern developments in rubber cultivation. One is an article in the Third and Fourth Quarterly Circulars of the Rubber Research Scheme (Ceylon) for December, 1935 by Mr. I. L. Cameron, entitled "Notes on a Visit to Malayan Rubber Estates," and the other is a contribution by Mr. H. W. R. Bertrand on "Rubber and High Shade" which appears elsewhere in the present number of this Journal.

Towards the end of 1935 Mr. Cameron went to Malaya to study the so-called "Forestry Methods of Cultivation," or "Cultivation under Natural Covers," which are coming into practice on many rubber estates in that country. These methods consist in allowing "upright indigenous forest plants of selected species, including self-sown rubber seedlings" to establish themselves gradually throughout rubber areas. This undergrowth is thinned out periodically by slashing it through at ground level and allowing it to decay and add humus to the soil.

Mr. Cameron during his visit was given facilities for studying the system in all stages of development until the final stage is reached, where only the more suitable plants, including rubber seedlings, are retained, the main object being to form a good mixed cover. He was also able to see examples of various anti-soil-erosion measures, such as leguminous covers, contour silt trenches, earth bunding, etc., which are gradually being superseded on many estates by natural covers. Some estates are

still clean weeding, a practice which leads in Malaya as in Ceylon to "serious soil erosion and loss of humus, resulting in poor foliage conditions and retarded bark renewals."

The most striking feature of this adoption of selected natural covers has been the obvious improvement in the general health of the rubber areas, as indicated by the top and lateral growth of healthy foliage, by the vigorous bark renewal, as observed by Mr. Cameron, and by increased yields, so he was informed. He does not hesitate to recommend "forestry methods" for Malayan estates, both in young and old rubber with suitable control.

After a discussion as to the possible application of these methods to Ceylon Rubber areas, Mr. Cameron considers that the system is well worthy of serious trial here by the Rubber Research Scheme and by estates. It is proposed to try these methods on an area on the Experiment Station, Peradeniya.

Mr. Bertrand's article should also be of much interest to rubber planters, suggesting as it does another possible solution of the problem of soil improvement on their estates. He gives evidence to show that the tropical rain forest in Ceylon is composed almost entirely of evergreen species and observes that this jungle, "even during the longest droughts, presents an almost unbroken dense green canopy. Beneath this canopy ideal conditions for the production, maintenance and functioning of a living soil obtain."

Mr. Bertrand deplores the conditions of soil desiccation and erosion which are being gradually created in Ceylon by the felling of evergreen jungles and the planting of "forests" of deciduous rubber trees. He is of opinion that neither leguminous ground covers nor natural bushy growths provide a satisfactory method of restoring the conditions of a forest soil on rubber estates. In order to counteract this gradual impoverishment of the soil under deciduous rubber, he suggests the gradual establishment of high shade trees, such as albizzia, in place of thinned-out low yielders, and in rubber areas which will have to be replanted. He gives examples from South India, Java and Ceylon of the vigorous health of rubber growing under and around interplanted albizzia, as opposed to the sickly appearance of the rubber in adjacent areas where there were no albizzias. The actual species of quick-growing leguminous trees which Mr. Bertrand has in mind is *Albizzia moluccana*, which he considers to be the most suitable tree available.

STUDIES ON THE COCONUT PALM III.

COCONUT HUSK

A. THE MANURIAL VALUE OF COCONUT HUSK ASH

M. L. M. SALGADO, Ph.D., (Cantab), B.Sc., (Lond.), Dip. Agric., (Cantab)

SOIL CHEMIST, COCONUT RESEARCH SCHEME

INTRODUCTION

THE present paper forms the first of a series of studies on the proper utilisation of husk for manurial purposes on coconut estates planned by the Soil Chemist's Department of the Coconut Research Scheme. Husks form one of the important by-products of the coconut palm that accumulate on estates, and except where husks can be sold at a remunerative price to fibre mills, these are mostly utilised in burying in shallow trenches between rows of palms, mulching round trees after manuring in circular trenches during drought, filling up drains and low lying portions of the land, and sometimes in the preparation of ash by burning. It is the object of this series of papers to examine critically these different methods of utilising husk. The present paper embodies results of investigations relating to the manurial value of coconut husk ash and the most suitable method for its preparation.

THE PRACTICE OF USING HUSK ASH AS MANURE

The high potash content of coconut husk ash was known quite a long time ago, the earliest analyses being those of Cochran (1897)[1] Bachoffen and Lepine (1900), the latter quoted by Prudhomme[3]. These analyses are all based on single nuts instead of large numbers and show considerable variation as shown in Table I. Cochran recommended the burning of coconut husks and returning the ashes to the soil, and pointed out that even at that time husks were being sold for less than their value as manure. He also drew attention to the high content of sodium chloride (salt) in the ash, and felt inclined to the view that a sufficient supply of common salt must exist in the soil or be supplied to the soil for the successful cultivation of coconuts. Later Rajapakse[4] quoting Bamber's analyses calculated the cash value of the manurial constituents of husk ash, and recently Croucher and Martinez[5] too have referred to the possibility of using husk ash as a potash manure.

TABLE I

RECORDED ANALYSIS OF COCONUT HUSK ASH

	By Lepine	Bachoffen	Cochran	Bamber	Croucher & Martinez
Total ash, per cent. of total weight ..	6·08	1·63	1·94	—	—
Sodium chloride	5·59	45·95	38·17	27·6	22·53
Salts of potassium	73·69	—	—	—	—
Potash (K_2O	—	30·71	31·23	15·5	31·28
Satls of caecium	18·42	—	—	—	—
Lime (CaO)	—	4·14	3·33	—	7·87
Magnesia	—	2·19	3·60	—	—
Calcium phosphate	0·98	—	—	—	—
Phosphoric acid (P_2O_5)	—	1·92	1·18	3·5	—
Silica	1·32	8·22	6·80	—	—
Carbonic acid	—	—	—	8·45	9·50

During the war, when potash imports from Germany were restricted, and the price of sulphate of potash rose to as much as Rs. 308·00 per ton in 1915, it is reported that potash was recovered on a large scale from husk ash and sold at remunerative prices. In Malaya where husk is not utilised for the manufacture of fibre, it is the usual practice to burn husk heaps in the field and broadcast the ashes.

In the course of advisory work it was observed that among certain estates, it was the practice to utilise a portion of the husks by conversion to ash by burning, and samples submitted for report were found to contain as much as 15 per cent. to 27 per cent. of water soluble potash as shown in Table II below:—

TABLE II

ANALYSIS OF SAMPLES OF COCONUT HUSK ASH FROM ESTATES

No. / Method of preparation	2A Burnt in open heaps	3A Burnt in open heaps	4 Slowly burnt in pits	7 —
Moisture %	7·11	7·99	8·29	16·42
Residue insoluble in dil. nitric acid	58·27	52·80	30·30	—
Potash (K_2O) water, soluble	15·66	20·89	26·93	14·83
Phosphoric acid (P_2O_5) ..	1·53	1·79	1·42	—

In view of the fact that the samples show considerable variation in their potash contents, and as no accurate data were available regarding the actual amounts of manurial constituents recovered in ash, it was decided to carry out a comprehensive investigation to determine the potash content of husks and the best conditions for the maximum recovery of potash by conversion to ash.

TABLE III

DETAILED ANALYSIS OF SAMPLES OF COCONUT HUSK ASH PREPARED FROM 100 HUSKS

	(1) per cent.	(2) per cent.	(3) per cent.
Moisture	2·47	4·87	7·81
Loss on ignition (carbon)	9·98	11·37	16·22
Residue insoluble in dilute nitric acid	23·00	24·45	34·86
Potash water soluble (K_2O) ..	35·60	32·72	31·36
Calcium oxide (CaO)	1·86	1·95	1·10
Magnesium oxide (MgO)	2·21	1·83	1·70
Phosphoric acid (P_2O_5)	2·20	1·97	2·02
Carbonates (CO_3)	13·10	14·01	12·26
Chloride as NaCl	23·32	21·95	20·29
Sodium oxide Na_2O	5·74	7·12	5·54

TABLE IV

RECOVERY OF ASH, POTASH & PHOSPHORIC ACID FROM 1000 COCONUT HUSKS

	Weight of 1000 husks lb.	Weight of ash from 1000 husks lb.	Ash per cent. of weight of husks	Potash (K_2O) per cent. of ash	Total Potash (K_2O) in 1000 husks lb.	Phosphoric acid (P_2O_5) per cent. of ash	Total Phosphoric acid (P_2O_5) in 1000 husks lb.
No. 1 .	141·65	24·91	1·76	35·60	8·87	2·18	0·54
No. 2 ..	135·58	25·57	1·89	32·72	8·37	1·98	0·51
No. 3 ..	118·50	25·57	2·16	31·36	8·02	2·02	0·52
Mean ..	131·90	25·37	1·93	33·23	8·42	2·06	0·52

EXPERIMENTAL

Three lots of 100 husks each were selected at random from a husk heap and carefully ashed by burning in a heap on a shallow tray made of corrugated sheets ; the ash was weighed and subsequently analysed, using the analytical methods described below :—

METHODS OF ANALYSIS

Potash.—Water soluble potash was determined in an aqueous extract using the gravimetric-cobaltinitrite method as described by Treadwell and Hall[6]. Comparisons with the volumetric cobaltinitrite-permanganate method according to Milne[7] showed good agreement.

Phosphoric acid was determined in a nitric acid extract as magnesium pyro-phosphate after previous precipitation as ammonium phosphomolybdate.

Calcium was determined in an aliquot of the nitric acid extract volumetrically after precipitation as oxalate, and *magnesium* in the filtrate as pyrosphosphate.

Chloride was determined in the aqueous extract and *sodium* by the Uranyl-zinc acetate method.

The data are summarised in Tables III and IV. The ash was found to contain as much as 30 to 35 per cent. potash, and two per cent. phosphoric acid. About 8 lb. of potash was recovered from 1,000 husks.

Experiments were carried out to determine the nature of the potash compounds in husk and find out if the potash salts tend to be easily leached. Two lots of husks were immersed in water in iron drums and retted for nearly two months. At the end of this period the total volume of retting water was measured and the potash in the solution determined. The retted husks were dried, ashed, and the potash in the ash estimated. The results are summarised in Table V and it will be observed that in spite of the fact that some of the husks were not completely immersed, and the experiment a rough one, over 50 per cent. of the potash salts in the husks, which exist mainly as the chloride and the carbonate, had been dissolved.

TABLE V

SOLUBILITY OF POTASH IN COCONUT HUSKS

No.	Total ash in retted husks	Per cent. potash in ash	Total potash in ash	Potash in solution	Total potash in original husk	Per cent. of potash soluble
	gms.		gms.	gms.	gms.	
1 ..	156	14·61	22·8	32·4	55·2	58·7
2 ..	222	22·54	50·0	36·0	86·0	41·8

The husks whose analyses are shown in Tables III and IV were obtained from a heap that had been exposed for some months to the usual monsoon rains, and in view of the observations stated in the previous paragraph regarding the solubility of the potash compounds in husk, there was the possibility that a certain amount of the potash may have been leached by rain. In order to test this point, fresh husks, immediately after husking, were ashed in lots of 100 and the ash analysed as before. The husks were obtained from nuts collected from the same field (having a sandy loam soil), from which the first lot of husks whose analyses are shown in Tables III and IV were obtained.

The results are shown in Table VI below :—

TABLE VI

COMPOSITION OF THE ASH OF FRESH COCONUT HUSKS UNEXPOSED TO RAIN (LOAMY SOIL)

No.	Total wt. of ash from 1000 husks	Per cent. Potash (K_2O) in ash	Total Potash (K_2O) in 1000 husks
5 ..	38·24 lb.	38·75%	14·81 lb.
6 ..	36·08 lb.	39·16%	14·12 lb.
Mean ..	37·16 lb.	38·96%	14·47 lb.

It will be observed from a comparison of Tables IV and VI that in fresh husks the amount of potash recovered is nearly double that of similar husks exposed to heavy rains, and amounts to about 15 lb. potash from 1,000 husks. The ash so obtained is a high grade potash manure, containing nearly 40 per cent. of potash.

As the soil type may have an influence on the potash content of husks, four lots of fresh husks from a gravelly field in the estate were ashed, and the ash analysed. The results are shown in Table VII.

TABLE VII

COMPOSITION OF ASH FROM COCONUT HUSKS UNEXPOSED TO RAIN (GRAVELLY SOIL)

No.	Total wt. of ash from 1000 husks	Per cent. Potash (K_2O) in ash	Total Potash (K_2O) in 1000 husks
8	28·79 lb.	29·7	8·54 lb.
9	30·79 lb.	32·2	9·91 lb.
10	30·62 lb.	31·1	9·52 lb.
11	30·15 lb.	31·5	9·50 lb.
Mean	30·08 lb.	31·1	9·36 lb.

The potash content of husks from trees growing on gravelly soil is much lower than those growing on a sandy loam and amounts to about 9 lb. from 1,000 husks.

DISCUSSION

CASH VALUE OF POTASH IN HUSKS

From the data shown in the previous tables it would be of interest to calculate the cash value of husks on the basis of the potash present. To produce a ton of ash containing 25 per cent. potash it is necessary to burn about 40,000 husks from nuts of trees growing on a loamy soil, and 60,000 husks in the case of nuts from a gravelly field. A ton of this manure can be valued at Rs. 85·00 so that on the basis of potash alone, 1,000 husks of the former would be worth about Rs. 2·00, and the latter Re. 1·50. This shows how uneconomical it is to sell husks to the mills at prices below these amounts.

The ideal method of utilising husks is to bury in trenches, between palms, especially on gravelly soils, but it often happens that far more husks accumulate than can be used according to the programme of cultivations. When this is anticipated conversion of the fresh husks to ash soon after husking, can be recommended.

METHOD OF PREPARING THE ASH

It may be mentioned that the preparation of ash should be carried out under a slow fire in order to obtain the maximum recovery of potash, and high temperatures should be avoided as potash salts are likely to be lost by volatilisation. High temperatures, especially when the husks are contaminated with sand, tend to produce fused hard clinker-like masses of ash in contrast to the fine dry powder of ash when the husks are burnt under a slow fire. In order to obtain a uniform grade of ash contamination with sand and stones should be avoided. The estate samples whose analyses are reported in Table II have been considerably contaminated in this manner, as shown by the large percentage of residue insoluble in dilute nitric acid. As the ash has a tendency to absorb moisture it should be stored in a dry place.

USE OF HUSK ASH IN MANURE MIXTURES

It should be noted that, in view of the alkalinity of husk ash, it is not safe to mix it with ammoniacal manures such as sulphate of ammonia, as these would react with the loss of ammonia.

SUMMARY

1. The ash obtained from burning coconut husks is a valuable potash manure, containing about 35 per cent. potash. About 2 per cent. phosphoric acid is also present. Complete analyses of samples of husk ash are recorded.

2. As the potash of husks exposed to heavy rains tend to be leached, the ash should be prepared soon after husking.

3. Husks from trees growing on loamy soils contain more potash than in those from gravelly soils ; about 15 lb. potash per 1,000 husks in the former and 10 lb. in the latter.

4. On the basis of the potash present, 1,000 husks from a field with a loamy soil would be worth about Rs. 2·00, and from a gravelly soil about Re. 1·50.

ACKNOWLEDGMENT

Thanks are due to my Assistant, Mr. E. Chinnerasa, for carrying out most of the analyses recorded.

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RUBBER AND HIGH SHADE*

H. W. R. BERTRAND

SUPERINTENDENT, GOVINNA ESTATE, GOVINNA

MUCH attention has been given lately to "forestry" methods in rubber. Briefly, these deal with the encouragement and control of a sub-jungle growth of Hevea seedlings and suitable indigenous bushy types. It is not the writer's intention to comment on these beyond reiterating what he wrote sixteen years ago, that it should be our aim to re-create, as nearly as practicable, the conditions of a forest soil. At present the argument lies, in Ceylon at least, between the advantages and disadvantages of ground cover such as Vigna and Pueraria, or bushy growths, and there is much to be said for and against both.

It is the purpose of this article to show that neither nor both fully meet the case.

THE EVERGREEN TROPICAL RAIN FOREST

I am indebted to the Economic Botanist, Peradeniya, who, on enquiry, kindly furnished the following information culled from Herbert Wright's "Foliar Periodicity of Endemic and Indigenous Trees in Ceylon", (Annals R. B. G. Perad. II. 1905) and Fred Lewis's "The Altitudinal Distribution of the Ceylon Endemic Flora", (Annals R. B. G. Perad. X. 1926).

"The total number of observed deciduous endemic species . . . is 17, or less than 3 per cent. of the arborescent flora, or 6 per cent. of the endemic trees in Ceylon. Though the percentage number of deciduous indigenous species is higher than this, it is nevertheless small, and the vegetation may therefore be regarded as *mainly evergreen* throughout the Island." (Italics mine).

Of the above species *Ficus infectoria* is doubtfully endemic, and *Canthium macrocarpum* has not been recorded below 3,000 feet. This reduces the number of species to 15, or much less than 3 per cent. Be it noted that all but one of the above are found in the wet (S.W.) zone. In fact only one deciduous species has been able to adapt itself to the long drought

*The Editor welcomes papers on subjects of general agricultural interest from outside contributors, but does not accept any responsibility for the views expressed therein.

conditions of the dry zone, and less than 3 per cent. have established themselves in the wet zone, where the inter-N.E. and S.W. drought is normally of not more than a month's duration. Nor is this a full statement of the case. The writer has not had an opportunity of taking a census of the relative numbers of the members of each species present in a wet zone forest, but he is in a position to observe daily some thousands of acres of jungle and it is undeniably plain that even during the "wintering" period of rubber nothing like 3 per cent. of the forest trees are "wintering." Moreover, such deciduous trees as can be observed, with a powerful prismatic, are, for the most part solitary. Unmixed colonies are rare, and the jungle, even during the longest droughts, presents an almost unbroken dense green canopy. Beneath this canopy ideal conditions for the production, maintenance, and functioning of a living soil obtain. Throughout the wet zone tropical belt of the world the forests for all practical purposes, may be called entirely evergreen.

This is a significant fact. Over aeons of time there must be a close adaptive relationship between the Soil and the Plant. From the fact that a small number of deciduous trees can and do flourish in wet zone jungles it may be assumed that the deciduous habit is, of itself, probably no great handicap to the tree. On the other hand, were the deciduous habit on an entire forest to react, over a long period, unfavourably on its soil under tropical conditions, it is reasonable to suppose that, in time, the soil would no longer be capable of supporting the trees and that they would ultimately be replaced by evergreens which, not only by themselves, but by the other phyla they encourage, would re-create a stable oecological condition.

HEVEA IS DECIDUOUS

We have felled evergreen jungles which through geological ages have adapted themselves to tropical conditions and which have, undeniably, maintained the balance of humus. In place of this we have planted "forests" of deciduous trees, which, even in their Brazilian home, we know, are comparatively few and far between. We have, in fact, created an oecological monstrosity.

It is the writer's belief that until that fact is realized we shall not get down to essentials of soil maintenance in rubber. If one looks over a vast area of "wintering" rubber and compares it with a similar area of jungle one must be struck with the fact that the one is creating conditions of desiccation and erosion which, in the long run, no manurially economic remedy, nor cover crop, nor bushy "forestry" methods can make good, whereas the jungle gives a hint as to a working compromise.

MANURE

It is clearly not possible for us to interplant evergreen trees in sufficient numbers fully to reproduce evergreen forest conditions, unless such trees were of economic importance ; so far we know of none, but it is possible that we can interplant a number sufficient to reduce our soil losses to within an economically replaceable amount. If such trees were nitrogenous they might go far towards meeting our nitrogen bill. If they were deep rooting they would, in normal laterite soils, supply all necessary potash. Nitrogen and potash are the two most expensive units, phosphoric is the cheapest, and it so happens that this is the unit to which legumes most readily respond. The phosphoric manuring of such evergreen leguminous trees may offer a cheap alternative to the present expensive and economically doubtful methods of direct application, provided that the number of evergreens per acre does not reduce the stand of rubber out of proportion to the benefits.

This opens two avenues to work on—(*a*) old rubber, (*b*) budded clearings. It is now tardily recognised that when the first bud from a high yielding scion was established it began a new era in rubber growing. The problem for those who intend to remain in the industry is no longer whether to replant or not, but how to effect the transition at a minimum cost, and how to retain the soil, and the trees last to be replanted, in the best condition at the least expense.

The complete replanting of most estates, if only for financial reasons, must take many years, meanwhile it will become an increasingly difficult and expensive problem to maintain the oldest areas in a condition for economic production. It may be that by sacrificing a sufficient number of the lowest yielders an adequate number of high shade trees could be established and that they would, in the long run, reduce the cost of maintenance. In clearings or replanted areas the establishment of high shade is not only easy but, as wind-breaks alone, is definitely beneficial.

ALBIZZIA MOLUCCANA IN RUBBER

In 1924 the writer and a friend visited South India and we were much impressed by the healthy condition of rubber growing under and round albizzias at a time when all South Indian rubber had been reduced to a shocking condition by repeated attacks of *Phytopthora Meadii* leaf-fall. There are three probable reasons for this—(1) the extra nitrogen and better soil conditions, (2) the wind-break effect, (3) control of the method of attack of the fungus.

(1). Ashplant found that heavy doses of nitrogen were beneficial against Phytopthora, but uneconomic. Nitrogen, apparently, did little directly to modify the attack, but excessive doses tended to reduce the pod formation (the source of the leaf disease), and increased the photosynthetic ability of the leaves which survived. The writer saw these trials and it was plain that no leguminous tree could release such stores of plant food and that the explanation must be sought mainly elsewhere.

(2). From the purely mechanical point of view anything which stops wind must arrest the carriage of spores. High trees are the most efficient wind-breaks, whereas a gale may be blowing in the tree tops, the lower levels of a forest are usually calm. Even a ten mile breeze blowing for 10 hours would mean that no less than 528,000 cu. ft. of spore infected air would impinge on every square foot of leaf surface exposed to it. In the case of such a disease as Oidium which apparently can attack either surface of a tender leaf this would be an important factor for it is only in the topmost strata of a forest that there is an appreciable lateral movement of the air.

CONTROL OF THE METHOD OF ATTACK OF THE FUNGUS

(3). In the case of Phytopthora this is probably the most important service performed by albizzias. In this connection the two principal facts are that (*a*) the spores can only attack the underside of the leaf or petiole, (*b*) they can only develop in water.

In the calm atmosphere under albizzias the rubber leaves are not blown up, nor their under sides wetted. Conditions are not favourable for attack. Examination of Hevea leaves in sheltered places will show that even after heavy rains the undersides are dry, except for exudation from hydathodes.

During a cycle of wet seasons Phytopthora leaf-fall is a factor in production not to be neglected even in Ceylon. In 1914 and 1925 most low country estates were stripped nearly bare.

Subsequent regular visits to India have confirmed these observations. Apart from a few trees which appear to be genetically resistant to the disease those with the best foliage are to be seen under or around overtopping albizzias.

In 1926 the writer assumed the " visiting " of a semi-dry zone estate of which some 600 acres had been practically abandoned, principally owing to labour difficulties consequent on malaria. In this portion the foliage was sickly, but there

were two where it was markedly healthy. One was where the trees were very densely planted and had not been thinned out, the other, and better, was where there were still a comparatively large number of albizzias. Elsewhere the albizzias had been ringed or uprooted.

In the same year the writer, with Mr. C. E. A. Dias, visited Djasingha Estate in Java. This enormous estate was a concession given by Governor Raffles some 100 years ago. Much of the land had been in many products, cultivated in the older ways, which caused great soil losses. On one portion an extremely valuable soil rejuvenation experiment was being carried out. A thoroughly "washed out" field of poor rubber had been selectively thinned in order to establish albizzias. These had, at time of visit, about reached the average height of the trees, but already the improvement in the rubber foliage was marked and easily distinguishable from that of a neighbouring field.

In sight from this bungalow there is a small property of 135 acres which the writer now manages. It was planted in 1917/18 on a hog-backed hill. Clean weeding and burning of weeds was regularly done. When the writer returned to planting in 1919 these "burnt offerings" could be seen on most dry afternoons. The soil got redder and the trees looked more unhealthy every year until they struggled into the bearing stage. About one-third along this hog-back some thirty albizzias were planted and allowed to grow. The estate has been under observation for the last sixteen years and there can be no question that this is the best part, one might say the only really good part of it. When the writer, comparatively recently, assumed management a yield census was taken and it was found that the average of the trees under and close to the albizzias was double the rest. Various experienced planters have visited the estate and all have been impressed with the superior growth and health of the trees and the better soil.

CONCLUSION

All wet zone tropical forests are mainly evergreen, but Hevea is deciduous. Under deciduous trees, which are not primarily adapted to the conservation of tropical soils, we are attempting to remedy the defect by planting ground or bushy covers. Were such a combination suitable for rain forest tropical conditions one might expect to find somewhat similar conditions prevailing in some part of the tropical zone. No such cases are known. We are, in fact, beginning at the wrong end, and, whatever may be, and un-

doubtedly are, the advantages of ground or bushy covers, we cannot hope to emulate true wet zone forest conditions until the land carries at least a fair compromise of evergreen trees.

2. The ideal would be a working proportion of evergreen nitrogenous trees of economic value. We know of none which fulfil these requirements.

3. The alternative is a quick growing leguminous tree which will overtop the rubber and last approximately as long as the probable economic life of a stand of rubber of up-to-date commercial genetic value.

4. *Albizzia moluccana* appears to meet these requirements better than any other known tree. It is easy to establish in clearings and confers special benefits on young trees. Its establishment in old rubber may be difficult, but by removal of poor yielders, and perhaps some pollarding, it might be possible to grow some 10 to 20 per acre. It is contended that this might help to tide over old rubber during the period of replanting and to improve the soil for future use.

DEPARTMENTAL NOTES

A NOTE ON FRUIT CULTIVATION

H. A. PIERIS, B.A. (Cantab), A.I.C.T.A. (Trinidad),
DIVISIONAL AGRICULTURAL OFFICER, CENTRAL

IN a country such as ours the scope for cultivation of fruit is unlimited, and yet it is surprising what little progress has hitherto been made in the establishment of fruit orchards on anything like an economic scale. Scattered here and there one finds small fruit gardens consisting of an admixture of fruit trees usually of the seedling type. The only variety of fruit grown on a moderately big scale is plantains. It is of interest to know that most of the plantain gardens are maintained by small holders in the home garden, settlements or chena clearings. In hilly regions in particular, sufficient precautions for preventing soil erosion are not undertaken, with the result that valuable top soil is slowly but steadily being washed off during the monsoons. The reason for the production of plantains on a fair scale is because this is about the only variety of fruit that finds a ready market. in different stages of maturity.

Fruit being perishable, requires a properly organised market for quick disposal. Very often small producers harvest their crops before proper maturity for the purpose of holding back the produce until good prices are obtained. This system is found to be satisfactory as growers are always certain of a fair market. If on the other hand fully matured fruits are brought for sale, growers are usually forced to sell their produce at low prices to middlemen working in a ring. Provided adequate selling centres, such as well organised fairs and markets, and easy transport facilities are made available, the existing difficulties can be considerably alleviated. Co-operative Agencies are necessary for collecting, grading and disposing of the small producers' crops. A factor that militates against the progress of the fruit industry is the absence of suitable buying and selling agencies. In the event of these organisations coming into being, the cultivation of fruit is certain to be widely undertaken by the small holders. Crops too will be harvested

at the proper stage of maturity. It is not due to a want of knowledge that small producers harvest their crops prematurely, but often due to private circumstances. An immature crop of fruit very often provides the grower with sufficient funds to meet some pressing domestic need. Such circumstances are usually the rule than the exception in the life of the average peasant in the Island.

There is a wealth of varieties of fruit suited to any type and condition of soil, climate, and elevation. The varieties range from those suited to sea level, up to altitudes well over 6,000 feet above sea level. The dry zone however provides a vast field for the growing of citrus types in particular. In areas where the rainfall is low and well distributed and where there are facilities for irrigation, the citrus family thrives remarkably well. The following varieties are recommended :— Grape-fruit, orange, mandarin, British Guiana lime and lemon. A well grown grape-fruit, orange or mandarin will always find a ready market. British Guiana limes are bigger and trees more prolific than the indigenous variety. Lemons, not to speak of the other varieties already mentioned, can be used for the preparation of cordials and fruit juices so very popular as a beverage in the tropics. An important by-product in the preparation of fruit juices, namely essential oils, could also be produced from the rind of most citrus varieties.

The cultivation of citrus presents ample opportunities in small holdings and peasant proprietary settlements, as a food and money crop. It is unfortunate that owing to ignorance or indifference, the use of grafts or budded plants is not sufficiently recognised. Seedling citrus plants are usually planted, which seldom or never bear true to the parental type. Vegetatively propagated plants produced by the combination of proven stock and scion need to be introduced.

An easy method of achieving this end is to select a few progressive cultivators from each range and provide them with instructions in the rudiments of vegetative propagation preferably at an Experiment Station where they will be able to study results of such experiments. Men trained in this manner should soon be in a position to put their training into practical use in their respective districts.

Maintenance of supply nurseries of suitable stock plants is important so as to permit of budding *in situ* and also for introduction of budded plants. An experiment on these lines was conducted recently in the Kotmale district. A batch of

selected cultivators was sent for training in methods of vegetative propagation to the Botanic Gardens. With a view to spurring them on to activity a competition was organised. Prizes were donated by the Planters' Association, Dimbulla. The competitors did excellent work and were responsible for the introduction of a number of budded citrus plants and also for pruning and trimming most of the old citrus trees in village holdings. The innovation has demonstrated the possibilities of further activities in this direction. It has also been decided to maintain a separate section at the Agri-Horticultural Show, Nuwara Eliya, next year, for exhibits of budded citrus plants brought for competition. When work on these lines expand, it is proposed to supply budwood from proven mother trees for purposes of budding and introduction of plants in the villages. Since the cost of budding knives often becomes prohibitive if such are to be purchased by small cultivators, a simple knife can be made of bone at a very nominal cost.

If the cultivation of fruit is undertaken on proper methods and on a bigger scale, not only could the internal requirements of the island be supplied with locally produced fruit, but there will be the possibility of establishing an export trade in fresh fruit, bottled, canned, and preserved fruit, essential oils, cordials and fruit juices.

FRUIT MARKETING IN MADRAS PRESIDENCY WITH SPECIAL REFERENCE TO ORANGES*

THE total area under fruits and vegetables including root crops in the Presidency is about ·7 million acres. Roughly a little over a third of this area, is under mangoes and about 20 per cent. under plantains ; only about 15,000 acres are under citrus fruits.

Most of the plaintains produced in our Presidency find a sale in the local shandies. The quantity that moves by rail to markets in cities and large towns, is of the order of about 8½ lakhs of railway maunds for the southern districts, of which, Madras City alone consumes more than a third. During the past few years, we are faced with the difficulty of finding proper markets for plantains, and, the possibilities of finding markets outside the province have had to be examined. In this connection, the Agricultural Department has been considering the development of export trade to North India, and with the co-operation of the railways has been able to obtain special rates for through wagons to certain cities in the north. Questions like quick transport, the provision of special wagons suitable for fruit traffic etc., are engaging attention. With the grant made by the Imperial Council of Agricultural Research intensive research work on plantain has been proposed to be taken up in Coimbatore and other plantain growing areas.

Although our position in respect of production of plantains is satisfactory, it is hardly so with other fruits. With regard to grapes, for example, we are importing heavily from Northern India to the tune of four thousand maunds, while our consumption of apples, which also runs to about the same quantity, is practically met from supplies from outside the province, as also from outside India like Japan, Africa and America. We have also no production worthy of the name in the case of plums, peaches and similar classes of choice fruits. Madras imports annually, plums to the extent of 800 maunds mainly from Mirzapore, and also from South Africa. All these facts are enough to show that in the matter of fruits there is a wide market, even in our own province, for expansion.

Let us now consider about oranges with which we are more concerned today. Although the area under citrus fruits is of the order of 15,000 acres, the acreage under oranges is limited to certain districts as follows :—

Sathgudi Oranges	..	Ceded Districts, Chittoor and North Arcot.
Coorg Oranges or Kamala (Loose Jacket)	}	Nilgiris, Salem, Madura, Vizagapatam and Godavari.
Salem (Tight Jacket)	..	Salem and Nilgiris in parts.
Batavin ..	..	West Godavari and Kistna.
Sour Oranges ..	..	Guntur, Kistna and Godavari.
Mozambique ..	..	Parts of Ceded Districts.

* A lecture delivered by Gopalakrishna Raju, Provincial Marketing Officer, Madras on the occasion of the opening of the Fruit Research Station at Anantarajpet on the 12th December, 1935 by the Hon'ble Mr. P. T. Rajan.—*The Madras Agricultural Journal*, Vol. XXIV, No. 1, January, 1936.

Besides these home-grown varieties, Madras imports largely from Nagpur, and smaller shipments from South Africa, Australia and America. Taking the case of Madras City, which is the largest consuming centre in the Presidency for oranges, the supplies during 1934-35 have been as follows : -

Nagpur Oranges	37,360	Railway maunds.
Sathgudi Oranges ..	35,000	,, ,,
Batavian (mainly) ..	7,000	,, ,,
Salem Oranges	4,000	,, ,,
South African Oranges ..	400	,, ,,

We have not yet received full figures from certain places, but from the figures already quoted, the supply of Madras is of the order of 90,000 maunds of which Nagpur oranges alone contribute about 45 per cent. These oranges have also found good markets in the south of the Presidency in places like Trichinopoly, Madura and Coimbatore. The last mentioned place alone is reported to consume 50,000 rupees worth of Nagpur oranges every year. Besides Nagpur oranges, the above three districts receive supplies from Coorg through the assembling market at Tellicherry. Even four to five lorry loads of 15,000 fruits each per day are consumed in the season from December to March. I have taken the imports first, as they are broadly indicative of our deficiencies, and therefore of our market avenues.

Let us next take the case of our home production. The *Sathgudi* oranges find a market largely in Madras City. They are very popular in Madras and fetch better prices than any other variety. Oranges from the Nilgiris are consumed largely in Coimbatore, Salem and Trichinopoly districts and to a small extent in Madras. The Salem orange finds a market in Madras and Coimbatore, but what is known as '*Cheeni*' in that variety is of the tight jacket type and very sour. It is a cheap orange and arrives early in the season, at a time when other oranges are scarce, and therefore finds a ready market. The loose jacket or *kamala* of the Circars finds a sale in the districts of production. It also moves to Madras, but the quantity is small as compared to Nagpur or *Sathgudi* oranges. The Batavians however are most popular in their own tract, and have not found extensive markets outside. They move in small quantities to Madras, Nizam's State, Karagpur and Vizianagram. Lastly, we have the sour oranges of Guntur which, on account of the dietetic value ascribed, have established a strong local reputation and are mostly consumed in the producing area.

I have so far given a broad indication of the movements of the trade in oranges in our presidency, but what we are more really concerned with is the direction of quality and movements in order to best make use of the supplies, to meet the demand. In considering this problem, we have to consider several points like the competition between different fruits, varieties of the same fruits, seasons of glut and scarcity, fluctuation in prices and lastly variations in the quality as well as quantity of demand. I am not going to enter into minute details here which will form the subject of a comprehensive survey we are now making of the fruit trade. But as a general indication of the tendencies involved and of the line of action to be adopted, I shall cite as an example the case of the Madras City, which as I have told you consumes annually about a lakh maunds of oranges from all sources. Taking the year 1934-35, it is found that the supply of oranges is limited in the months of June-July, being only about one thousand maunds in each case. This supply increases to 6,000 maunds in August, and 9,000 maunds in

September. Up to this point, the contribution is almost entirely from the *Sathgudi* oranges, with very little competition from other sources. It is on this account that this variety fetches very good prices at that time, the prices being so high as Rs. 2-8-0 per dozen for the best grades, and about a rupee for the smaller sorts.

But in the months of October-November the loose jacket or *kamala* from the Circars reaches the Madras Market. The first stage of competition begins now and wholesale prices fall from Rs. 10 to Rs. 5 per hundred, for the top grade of *Sathgudi*. This fall in prices continues until January, and supplies amount from eight to ten thousand maunds per month. From January onwards competition of a different kind is introduced with the onset of Nagpur oranges. In December they arrive in small consignments, but from January onwards they are consigned in special wagons attached to passenger trains from Nagpur or Katol, each wagon carrying 1,200 to 1,500 baskets of fruits. Altogether 80 such wagons arrived during last season, the period of peak being in February-March. From March onwards, the supply of Nagpur oranges goes down, the quantity in May being only 5,000 maunds, and still less in June-July.

I have given you a broad idea of the supply and demand of Madras City, which is the largest market for oranges in the province, as an indication of the market conditions during the year. The practical consideration that should guide us in laying down any policy of future programme, consists essentially in making the best use of the supplies to meet the demand. As already indicated in my figures, there is a deficit supply of oranges in the city in the months of May, June and July and a glut in December to March. It is this variation that is responsible for the large fluctuation in prices that occurs in the same season in the fruit market. But with proper marketing such variations should be reduced to a minimum. The chief aim is to ensure a stability of supply and fair prices in the trade, to benefit the consumer as well as the general trade. In order to ensure this, two things can be done : the first is the exploitation of new markets during glut and the second the prolongation of the marketing period by methods such as cold storage, to get a more evenly distributed supply.

I shall deal with the problem of gluts first. In the season the Madras market gets over-full, the commission agents dispose of their stock to their customers at Trichinopoly, Madura, Tanjore and Salem districts. Direct marketing to these centres is done in the case of Nagpur oranges by agents who settle there in the season. For the home produce a first improvement can be effected by greater direct booking to the centres, avoiding by that means a glut in Madras. This will also ensure a greater uniformity of supply to the consuming areas. At present, Salem oranges move to towns in the South like Tanjore and Mayavaram, but the demand for other varieties also exists. From our studies, we find that a demand for superior varieties and better quality exists in the centres at Coimbatore, Trichinopoly, Madura and Tanjore. Similarly the West Coast can take in better varieties like the *Sathgudi* in place of the commoner quality largely used now. The " Eat more fruit " campaign in England has contributed largely to increase consumption, and there is no reason why similar results should not be achieved elsewhere. Already thanks to the high value attached to fruits by the medical profession and by nutrition experts people are taking more and more to fruit diet especially oranges.

This leads us as a next step to the improvement in varieties which is a natural essential for market expansion. There is much scope for work in this connection. Many of the gardens in certain districts are not properly cared for, and in these are grown sour oranges instead of the better varieties. Trees are grown in shade, no attempt at pruning or cultivation is made and the plantation lives a hand to mouth existence. It is in this aspect of the problem that the fruit research station, which is being established under such good auspices, will open out possibilities. Our province has also yet to develop greater experiences in the use of citrus graft through adaptability to different conditions and also the bearing of stock on scion. In this direction also will this fruit research station contribute to our future. Introduction of finer varieties like the Washington-Navel orange, to suit the demand from special consumers, and research in the methods of pruning, manuring and cultivation will also go side by side. At Coonoor, inarching has met with greater success than budding, but in the Batavian tract greater success at budding has been reported to have been achieved by some growers.

Let us now consider the methods of organisation necessary to develop marketing. A common feature of our existing conditions is the wide gap between the prices paid to the grower and that paid by the consumer. In America and Africa this spread between the growers' and consumers' prices has been sought to be remedied by the creation of marketing organizations which have developed enormously in these days. The assembling and grading of fruit, packing, provision of cold storage, inspection at ports of consignment and delivery are all done by these associations. Fruits travel several thousand miles on land and sea and have found markets all over the world. The Co-operative Organisation of the Californian Fruit Growers handles more than ten million dollars worth of fruit every year. The local associations do business up-to a lakh of dollars each. The work is carried on by a central exchange with district branches. So far as *Kodur* oranges are concerned it is a well known fact that there are more than two or three intermediaries before the fruits reach the consumer *viz.*, the contractor or the lessee of the garden, commission agents and godown owners in Madras, the wholesaler, retailer, etc. If an Association of fruit growers of this area be formed and arrangements made for the establishment of sale agencies in Madras and other principal centres in the Presidency, it should be possible to realise better returns than now. The aims and objects of such an Association will be :—

1. To organise the marketing of fruit on a co-operative basis by adopting the improved methods in grading, packing, etc., and by establishing sale agencies wherever found necessary in order that the growers may secure better value for their produce.
2. To finance the growers, so that, if necessary, they may pledge their crop to the Association and not to contractors who now lease out their gardens at a low rate in the early stages of growth of the fruit.
3. To obtain necessary requisites such as seeds, plants, manures, implements etc., on a wholesale basis and to supply these to the garden owners as cheaply as possible.
4. To arrange for careful handling and rapid transport of the fruit on Railways and to secure reasonable concession rates.
5. To supply the services of specially selected *maistries* to assist growers to lay out or extend their gardens and renovate old ones, to bud, prune, etc.

6. To organize fruit shows so as to stimulate better production grading, packing and marketing.
7. To issue to members free of charge, posters, leaflets, etc. containing information about seasonal operations, prices and other marketing news.
8. Generally to take such steps as would encourage fruit growing within the district by obtaining all possible assistance and support from Government and public bodies.

In a work of this kind, however, our country has much to learn. The first point to remember is that of grading and standardisation of fruits. The existence of standard grades is a common medium of understanding between grower and consumer and between buyer and seller, even when separated by long distance. It also makes for a steady market and an assured supply of what is wanted. If we look at any package of the South African or American fruit for example, what we find is that all the fruits are of one size, of guaranteed variety and free from blemishes. The consumer, and specially the better class of consumer, is prepared to pay for this. Gradually the existence of grades will also fix the nature of demand and result in less delay in transport in reaching suitable destinations. At present, sorting of fruits is done in a small way by the wholesale commission agents at Madras and again at the retail market. It is on this question that growers have to improve themselves most. The marketing survey now in progress is engaged in the fixing of standard grades on an all-India basis suitable for more efficient trade, and with the growth of healthy organisation this part of the work is bound to expand considerably.

The ultimate aim of marketing organisations will be to reduce costs at all stages of marketing while providing for large increases in the trade. The pooling of produce is at present largely done by contractors at the wholesalers' godowns in Madras but we have often had reports that full amounts have not been paid. A healthy system of marketing finance from growers' organisations, has been a very useful remedy in this connection, but in a perishable commodity like fruit, a certain amount of care is indicated. A necessary condition for such organisation is that they should represent a large body of the growers. Otherwise success cannot be achieved. It is only in recent years that we are seeing attempts at such organisation, but greater effort is needed to make them serviceable. I need hardly add that the marketing section will render all possible help to foster the growth of such associations. It is by no means to be inferred from this that the services of middlemen will be entirely dispensed with, but costs can be reduced considerably, while periods of gluts and depression can be more adequately dealt with.

As a necessary accompaniment to work of development must be mentioned the development of technique in the methods of grading, packing and storage. I have already indicated the advantages of standardised grades, but the question of next importance is that of storage. Countries like Africa and America that have established a wide export trade have arranged for a systematic erection of cold storage plants to fit in with assembling centres. In our own country, the Bombay department have conducted trials on the cold storage of mangoes. The findings are that while Alphonso and Salem varieties respond well to treatment, the Circars variety '*Swarnarekha*'

does not. It is said that the storage life of fruits can be extended by even about 60 days by proper cold storage methods. The economic advantages of this are obvious. For instance, I have already pointed out that there is a deficiency of supply in June-July. If the glut of April could be preserved in cold storage up to May-June, there will not only be a more even supply but better prices could be got. Also fruits imported from abroad, which are transported under cold storage, require cold temperature during keeping at ports, and the erection of cold plants will therefore be advantageous.

In considering the necessity for cold storage plants it is well to remember that the methods for pre-cooled plants on the field are different from those adopted for fruits which have already been handled in transport. Internal breakdown is more difficult to avoid in the latter case. The special conditions necessary for such work in India are to be fully studied, but it is a necessary condition for long distance transport and for export trade. There are wide markets for citrus fruits as in England which imports annually from two and half to three lakhs of tons of oranges every year, but such considerations though not immediately indicated, should be borne in mind in our developmental work for the future.

There is also another method by which gluts in the market can be avoided, and that is by the fruit preserving and transforming industry. The Bangalore Institute reports favourably on the vitamin content of some of our citrus fruits, and results obtained in North India point to considerable success in this direction. Fruits can be preserved with and without sugar, under particular conditions, but the need for such work is indicated only in case of gluts or over-production as for instance in the case of pears in the Nilgiris or limes in certain parts of the Presidency. As for oranges there appears sufficient demand at present for fresh fruits although some centres as in the Nilgiris and Salem are not finding the full market. I daresay this fruit research station which is started under expert control will open out avenues for further expansion. As in all cases of special preparations a market for such products is really created, and not necessarily existing. In the expanding use of such products as fruito, vimto and the ice frute, and in our many classes of aerated drinks, we see conditions for development which will be fruitful of results for the future of the fruit industry.

I have in this short discourse given you some broad lines of improvement in the marketing of fruits, necessary for future expansion. I have given you indications of our supply, the nature of imports and the movements of home produce. I have also indicated to you the lines on which future research work on varieties, cultural methods, storage and the transforming and preserving of fruit, will help us. I have stressed the need for standardisation in our marketing methods and the growth of healthy organisation towards such ends. I am sure that the fruit research station on which devolves some of the technical problems of our future will give ample scope for the expansion of the activities which the marketing staff are now engaged in.

HANDLING AND CURING VIRGINIA BRIGHT TOBACCO*

THE following notes dealing briefly with several of the common problems and some of the faults made in flue curing may possibly be of assistance to tobacco growers at the present time.

Many of the difficulties in the curing of tobacco may be directly traced to the field. For instance, such factors as unsuitable soil, fertilisers, field management and adverse climatic conditions all exercise some influence on the standard of curing operations.

Soil.—The use of unsuitable soil is a matter which can, in most instances, be eliminated by a more careful selection of land for the type of tobacco to be produced. The class of soil upon which it is grown largely influences the type of leaf produced; it is therefore not considered sound practice to plant tobacco on a heavy soil and endeavour to force the resulting leaf to cure a very bright colour. Exceptions to the above rule do occur, especially when virgin land is used. Under these conditions and provided seasonal conditions are favourable, general experience has proved that the first crop tends to produce a fair percentage of bright coloured leaf: the tobacco planted during the following season, however, usually produces a heavier bodied and darker coloured leaf. Any attempts made by the grower to force the second crop to cure as high a percentage of bright leaf as was secured from the first crop grown on the same land, are almost certain to result in disappointment and financial loss through a reduction in quality. The use of an excessive quantity of moisture for a prolonged period and an extended period during which the leaf is submitted to the heat of the barn are detrimental. Tobacco treated in this manner is generally neither one thing nor the other, and besides being unattractive in appearance, is also dry and brittle.

An experienced grower can usually determine by the appearance of the tobacco in the field whether the bulk of the leaf is naturally inclined to cure bright, medium or dark, and arranges his curing accordingly. Speaking generally, the lower leaves tend to cure bright, the middle leaves produce medium grades and the upper leaves cure into darks; therefore leaf harvested from different parts of the plant should not be placed in the same barn for curing.

Fertilisers.—The choice of fertiliser must of necessity be governed by the type of land used for the crop. It has been found that a complete fertiliser containing a combination of both organic and inorganic nitrogen-furnishing elements is very suitable for use on the lighter types of sandy soils, the majority

* By D. D. Brown, Chief Tobacco Officer, in *The Rhodesia Agricultural Journal*, Vol. XXXIII., No. 1, January, 1936.

of which are granitic origin. Sandy loams and clay loams of medium fertility respond favourably to applications of complete tobacco fertilisers containing either a percentage of organic nitrogen or the total percentage of nitrogen derived from an inorganic source. On the heavier textured and more fertile soils, however, a double complete tobacco fertiliser in which all the nitrogen requirements are derived from an inorganic source is generally favoured, or special mixtures similar to the above, only that the percentage of nitrogen may be less.

Organic nitrogen forms an essential part of the fertilisers supplied, especially for dark fire cured tobacco, where the requirements are rather different from those for flue cured tobacco.

Apart from the choice of a suitable fertiliser, there is the application of adequate dressings ; inadequate applications are false economy, whilst, on the other hand, excessive quantities are wasteful. Owing to the varying degrees of inherent fertility of the soil it is not possible to state the quantity of fertiliser which is to be applied. Only actual trial will enable each individual tobacco grower to determine the quantity of artificial fertiliser which will produce optimum results.

The continued application of artificial fertilisers is in itself not sufficient, and, if continued for too lengthy a period without any provision being made to maintain the humus content of the soil, will actually be detrimental.

Field Management.—Thorough preparation of the land in the first instance, followed by proper cultivation and cultural methods, will materially influence the results of the subsequent curing operations. The crop is then more likely to make continuous and more even growth, which will give greater uniformity in the leaf. A plant correctly primed and topped will ripen more uniformly and produce better tobacco than a plant which is unprimed and topped either too high or too low. The time of planting is also important; less difficulty is usually experienced in curing tobacco planted during the earlier part of the season than with the later planted portion of the crop.

Climatic Conditions.—During seasons when climatic conditions are unfavourable it is usual to expect certain difficulties in the curing of the crop. Should a prolonged dry spell occur when the tobacco is reaching maturity, the leaf turns yellow and commences to perish on the plant. This type of leaf when placed in the barn yellows well and retains a good colour until the temperature of the barn is raised approximately to 130° F.; at this stage a change in colour is often observed, the leaf turning green and curing out with a decided greenish tinge. This is due to the leaf being immature ; the yellow coloration in the field is an indication of the plant perishing, though it is often mistaken as a sign of ripening. When false ripening is in evidence the harvesting is best delayed for a short while, say, a week or ten days, as very frequently a shower of rain will arrive in time to prevent the plants from dying off any further. Should the dry weather continue, or the leaves begin to deteriorate rapidly, the only course is to proceed with the reaping. The incidence of heavy or continuous rains after a dry spell will induce second growth, which makes the leaf very difficult to cure, and very often such leaf will fail to cure at all. When attempting to cure tobacco of this nature a

slow rate of curing is essential until the requisite yellow coloration is obtained : care should also be taken not to rush the temperature up too fast before all the green possible has been eliminated. It is sometimes advisable to yellow the leaf first by hanging the sticks in a wilting shed before placing the tobacco in the barn. During seasons of heavy rainfall the tobacco in the field will sometimes turn yellow prematurely, though in this instance it is generally found that the curing yields more satisfactory results than is the case when drought prevails.

Every effort should be made to eliminate or reduce to a minimum the green tobacco irrespective as to whether the season be favourable or otherwise even though this be only attained through sponging some of the leaf. Sponged tobacco retains a commercial value, whereas green tobacco is practically valueless.

Harvesting and Curing.—Leaf fully ripe and of uniform body and texture should be reaped for each barn ; reasonable care exercised in this respect will materially assist in the curing operations. Damaged and inferior leaf is often harvested and used in place of better leaf which, if left on the plant too long, loses quality. The leaves to each hand should be placed back to back when tied on the stick ; the number of hands should fill the stick without overcrowding. When filling the barn the tobacco sticks should be evenly spaced along each tier and overcrowding the barn avoided. The leaf is more liable to "sponge" in an over-filled barn and during wet weather "pole sweat" will occur. The amount of "sponging" can usually be controlled by opening the ventilators and slightly increasing the temperature ; increased ventilation and temperature, with a reduction in the relative humidity, is also required to control "pole sweat."

Bottom ventilation must be carefully regulated when the outside atmosphere is either saturated or extremely dry ; under these circumstances it is often advisable to keep the lower ventilators closed or only very slightly opened. When little or no bottom ventilation is used, it is necessary to commence ventilating at the top as soon as the temperature in the barn is 100° F. to 105° F., if the leaf shows any signs of sponging. The top vents are at first opened very little and the aperture gradually increased as the curing proceeds. The above method is useful in eliminating a certain amount of the green when a mixed barn is being cured. The timely use of top ventilation to prevent the yellow leaf from "sponging" and a minimum of bottom ventilation prevent the atmosphere of the barn from drying too rapidly, thus leaving the greener tobacco more opportunity for "yellowing."

Under normal conditions the tobacco grower should use his standard methods and formulae which personal experience has proved to yield the most satisfactory results in curing the crop.

The provision of warm air ducts leading into the barn will also enable the grower to cure his leaf to better advantage. This system is recommended in place of the present practice wherein cold air is commonly introduced into the barn.

An excessive quantity of water thrown on to the floor will induce "sponging," particularly in the case of earth floors. It has often been observed that

a thoroughly saturated earthen floor causes difficulty in reducing the relative humidity when the temperature has reached 130° F. approximately. At this temperature a great deal of moisture is driven out of the floor; hence the increased humidity within the barn, even though the same barn appeared to have the correct degree of relative humidity at, say, 120° F. to 125° F. Brick floors should be provided with a thin coating of cement for preference, as it is then easier to control the humidity, especially if drain plugs are let in through the walls to run off surplus water when it is no longer required in the barn.

As the curing season progresses the rate of curing gradually becomes slower, the leaf takes longer in colouring and fixing the colour. A great deal of damage to the tobacco is incurred through raising the maximum temperature too high during the final stages of curing. A maximum temperature in excess of 160° F. should not be permitted, as higher temperatures will rapidly cause the leaf to deteriorate, rendering it dry and brittle, besides scorching it to some extent.

After the tobacco is cured it is a common practice to bale the leaf immediately after it is removed from the barn and has been "conditioned," the reason usually advanced for this procedure being lack of storage room. Whilst tobacco in bales might possibly require less floor space for storage, the saving in space is not always so great as is imagined; in fact, the reverse is often the case. The practice of baling before grading is to be deprecated, as this method entails a deal of wastage, besides rendering subsequent grading more difficult owing to the tobacco having been tightly pressed and the leaves in consequence being hard to separate. Another disadvantage is also apparent when the tobacco has been baled too dry to improve in colour and aroma.

When "bulked" the tobacco can be "conditioned" to a correct degree which fulfils the requirements of the type of leaf, and if properly handled the tobacco will improve more rapidly. There is also less cause for wastage and the tobacco is more easily examined in the bulks than when in bales. If the tobacco is roughly graded into brights, mediums, darks and greens prior to being "bulked," much time will be saved in the final grading, and bulks containing only one class of leaf can be handled to better advantage. The bright bulks would naturally be those first chosen for final grading and baling, followed by the mediums, darks and greens in the order stated. When only one class of tobacco at a time is being handled, less difficulty in grading is experienced by unskilled native graders.

Steam, superheated or used in excess, is also liable to reduce the quality and value of the leaf.

In conclusion, it is not suggested that the above notes deal completely with the subject under review, and reference therefore should be made to previous articles on tobacco culture published in the *Rhodesia Agricultural Journal*, from which reprints are available in bulletin form.

WEEDICIDES*

STRENGTHS OF APPLICATION

ENQUIRIES are frequently received with regard to the concentrations of various chemicals when used for the destruction of weeds, and this article serves to summarise information concerning the more commonly used weedicides.

Owing to the expense of both material and labour, chemical sprays for the eradication of weeds are not generally recommended. Under certain circumstances, however, where cultural methods are not practicable, they serve a useful purpose. Sprays are used mainly for the control of such vigorous perennial weeds as Canada Thistle (*Cirsium arvense*) and Skeleton Weed (*Chondrilla juncea*) which have underground stems capable of producing new plants from small severed sections. Cultivation under these circumstances, unless repeated very frequently, would merely serve to spread the weed. Again, railway tracks are frequently cleared of plant growth by means of a chemical spray applied from a moving locomotive. Gravel paths and tennis courts are often difficult to keep free from weeds and as the disturbing of the surface, particularly in the case of a gravel tennis court, is not desirable, the use of a spray is very convenient. Such selective weedicides as arsenic pentoxide and sulphate of ammonia may be employed for the destruction of annual clovers and other weeds in lawns.

In the following section information is given concerning the more commonly used chemical weed-killers.

Sodium chlorate.—Sodium chlorate is probably the most successful weedicide in use at the present time. A 2½ per cent. solution (*i.e.*, 1 lb. to four gallons of water) is sufficiently strong to kill comparatively weak annual weeds such as chickweed (*Stellaria media*) and nightshade (*Solanum nigrum*). For general purposes a 10 per cent. solution (1 lb. to 1 gallon of water) is recommended, while in exceptional cases, such as when dealing with Blackberries (*Rubus fruticosus*), a 15 per cent. solution can be used at times with advantage. Improved results have been obtained by adding glue to sodium chlorate prior to application. Experiments carried out recently at the Wagga Experimental Farm indicated that the maximum destructive results with Skeleton Weed (*Chondrilla juncea*) were secured by the application of a 10 per cent. solution, containing two ounces of glue per gallon at the rate of 150—200 gallons per acre. Acidification of the spray by the addition of

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* C. R. W. Meadly, B.Sc., Botanical Branch in *Journal of the Department of Agriculture*, Vol. 12, No. 4, December, 1935.

¼ tea-spoonful of sulphuric acid per gallon is reported by Sampson and Parker to increase the efficiency of sodium chlorate spray used against St. John's Wort (*Hypericum perforatum*) (1).

Full particulars regarding method of application, dangerous properties, etc., are contained in Leaflet 330 (2) of this Department.

Calcium chlorate.—This is available usually as a proprietary line mixed with calcium chloride, such as "Weedex." The chloride content absorbs moisture from the atmosphere and thus considerably reduces the fire risk compared with sodium chlorate. Under local conditions, pound for pound, sodium chlorate has proved more effective than commercial chlorate, but by increasing the concentration of the latter in order to make the chlorate contents comparable, the calcium compound has given encouraging results. Concentrations recommended according to the type of weed range from 5 per cent. to 30 per cent. (½ to 3 lbs. per gallon). As with sodium chlorate, the solution should be applied to the foliage in the form of a fine spray, according to instructions contained in leaflet 330 (2).

Sodium arsenite.—White arsenic, arseneous oxide, is not readily soluble in water, but when boiled along with equivalent quantities of washing soda or caustic soda, soluble sodium arsenite is formed. This substance is not inflammable, but is dangerously poisonous to all classes of animals. Details concerning the preparation of this substance and methods of application are contained in Leaflet No. 442 (3).

A solution made up from 1 pound white arsenic, 1 pound washing soda and thirty gallons of water, is suitable for killing weak growing weeds such as chickweed (*Stellaria media*), while a 1-1-4 solution is suitable for strong growing perennial weeds such as Nut Grass (*Cyperus rotundus*). Improved results are reported by adding sulphuric acid in order to produce the acidity necessary for penetration (1). Just prior to use, the addition of 5 per cent. by weight of concentrated sulphuric acid is recommended. Sodium arsenite is usually used on gravel paths and hard tennis courts where there is no chance of stock gaining access to the poison. The 1-1-4 solution along with ½ lb. of whiting for marking purposes is also used for pouring into the frills of green timber which has been frill ringbarked. This hastens the killing action of the ringing and also reduces suckering.

Ammonia sulphate.—Sulphate of ammonia assumes a dual purpose as it may be used both as a weedicide and a fertiliser. Many annual clovers such as Hop Clover (*Trifolium procumbens*), Sucking Clover (*T. dubium*) and Woolly Clover (*T. tomentosum*) invade our lawns and provide a laborious task if they are to be hand weeded. The application of a 2½ per cent. (¼ lb. to 1 gallon) solution of ammonium sulphate does much to reduce the clover content of a lawn, at the same time acting as a tonic to the grass. The solution may be applied by means of a watering can at the rate of about 1 gallon per eight square yards.

The addition of one part of calcined sulphate of iron to every three parts of ammonium sulphate will improve the weed-killing properties and also produce a darker green colouration in the grass. There is an alternative dry mixture consisting of three parts of ammonium sulphate, one part of calcined iron sulphate and twenty parts of sand, used at the rate of four ounces per square yard. The number of applications depends on the weediness of the lawn, but the treatment should be continued at approximately fortnightly intervals (4). Watering or rain is not desirable after application.

Taprooted weeds such as Flat Weed (*Hypochoeris spp.*) may be eradicated by means of a mixture made up as follows :—

7 parts sulphate of ammonia,
3 parts calcined sulphate of iron
10 parts of sand.

A pinch of this should be applied to the crowns of the weeds during fine weather. A second application after an interval of about ten days will generally result in the death of the weeds.

Arsenic pentoxide.—This substance has been used with considerable success as a selective weedicide on lawns, bowling greens, putting greens, etc., in New Zealand (5) and has also given satisfactory results under local conditions. The lawn should be mown prior to treatment and the foliage should be quite dry so that dilution of the solution does not occur. For general purposes a 1-80 solution, *i.e.*, 1 lb. of arsenic pentoxide to eight gallons of water, should be used, but for badly weed-infested lawns under wet conditions a 1-60 solution gives best results and is quite safe.

The required quantity of arsenic pentoxide should be dissolved in about 1 gallon of cold water and then diluted to the required strength. The solution should be applied in the form of a fine spray at the rate of about 240 gallons per acre. Plants killed by this treatment include Winter Grass (*Poa annua*), Flat Weed (*Hypochoeris spp.*) and the troublesome annual clovers. Arsenic pentoxide is poisonous and if the hands are wetted unduly during spraying operations, harmful burning occurs in the quick of the finger nails.

Sulphuric acid.—Sulphuric acid is used to an appreciable extent in Europe for the eradication of weeds, particularly Cruciferous weeds such as Charlock (*Brassica sinapistrum*) in crops. Spraying is done when the weed is in the seedling stage, a 5 per cent. solution being the usual strength applied at the rate of 100-200 gallons per acre. Experiments carried out in Arizona (6) showed that under the existing conditions a 5 per cent. solution killed most farm weeds including Dodder (*Cuscuta spp.*), but several applications of a 10-15 per cent. solution were required to kill Johnson Grass (*Sorghum halepense*) and Nut Grass (*Cyperus sp*). The acid does not readily adhere to the vertical leaves of cereals and has little effect on them apart from a temporary browning.

The commercial concentrated acid may also be used for killing Flat Weeds (*Hypochoeris spp.*) in lawns. A few drops from a pipette dropped into the heart of each weed is sufficient.

Sulphuric acid must be handled with extreme care owing to its damaging action on the skin and clothes as well as the corrosion of most metals, particularly when dilute.

Iron sulphate.—This is also used in Western Europe for the destruction of broad-leaved plants, particularly Charlock and Wild Mustard in cereal crops. The usual recommendation is a 20 per cent. solution applied at the rate of 50 gallons per acre when the weed seedling is in the four-leaf stage.

Copper sulphate.—This is used for the same purpose as iron sulphate, but is somewhat more expensive. Fifty gallons per acre of a three per cent. solution is the usual application.

Common salt.—Common salt should only be used under exceptional circumstances owing to the lasting detrimental effect on the soil. It is suitable for gravel paths, tennis courts and other places where no vegetation is desired. One to two pounds per square foot or twenty to thirty tons per acre applied in a dry state is the average requirement.

There are various other preparations undergoing trial, but not in general use, such as ethylene dioxide, ammonium sulphocyanate and certain chromates. Those listed above, however, are the chemical weedicides most in use at the present time.

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MINUTES OF THE SIXTH MEETING OF THE CENTRAL BOARD OF AGRICULTURE

THE sixth meeting of the Central Board of Agriculture was held in the Board Room of the Department of Agriculture, Peradeniya, at 2 p.m. on Thursday, January 16th, 1936.

Dr. J. C. Hutson (Acting Director of Agriculture) presided and the following members were present: Messrs. C. Arulambalam, A. C. Attygalle, P. B. Bulankulame, A. Canagasingham, R. G. Coombe, C. E. A. Dias, E. C. de Fonseka (Jnr.), James Forbes (Jnr.) (Chairman, Tea Research Board), R. P. Gaddum (Chairman, Planters' Association of Ceylon), Montague Jayawickreme, J. L. Kotalawala, S. Muttutamby, Wace de Niese, Dr. R. V. Norris (Director, Tea Research Institute), Messrs. T. E. H. O'Brien (Director of Research, Rubber Research Scheme), Graham Panditteseker, S. Pararajasingham, Wilmot A. Perera, W. V. D. Pieris (Officiating Chief Technical Officer, Coconut Research Scheme), F. A. E. Price, L. W. A. de Soysa (Chairman, Low Country Products Association), E. L. Spencer-Schrader, U. B. Unamboowe, C. Huntley Wilkinson, Mudaliyar N. Wickremaratne Mr. M. Crawford (Government Veterinary Surgeon), Dr. A. W. R. Joachim (Agricultural Chemist), Mr. W. C. Lester-Smith (Controller, Plant Pests), Dr. J. C. Haigh (Economic Botanist), Mr. L. S. Bertus (Acting Mycologist) and Mr. F. P. Jepson (Acting Secretary).

Visitors.—Messrs. S. J. F. Dias, R. Patrick and G. W. S. Sturgess.

Intimation of their inability to attend the meeting was received from the following members: Messrs. C. L. Wickramasinghe (Commissioner of Lands), L. L. Hunter (Government Agent N.C.P.), J. S. Kennedy (Director of Irrigation), S. Armstrong, G. Bruce Foote, S. M. K. Madukande, F. A. Obeyesekera, H. F. Parfitt, P. B. Ranaraja, Rolf Smerdon, E. C. Villiers, Col. K. D. H. Gwynne, Rev. Father L. W. Wickremasinghe and Gate Mudaliyar A. E. Rajapakse.

CONFIRMATION OF MINUTES

The Chairman indicated that the minutes of the last meeting had been printed and circulated to all members and before confirming them he would be glad to know if any member had any questions to ask. Arising out of the minutes, Dr. R. V. Norris inquired whether the declaration of the Spotted Locust as a pest was limited to the area around Kotmale and whether any measures had been prescribed for the control of the pest under the Plant Protection Ordinance. The Chairman replied that the only action which had been completed was the declaration of the insect as a pest. The next step would be to define the area infested by the pest and to prescribe control

measures. The area which it was proposed to define as infested was the Tispane Korale of the Kotmale Division. This area could be added to later if the necessity arose.

The minutes were then adopted by the meeting and confirmed.

The Chairman said that before passing on to the next item on the agenda he had to announce, with regret, the death which had taken place, since their last meeting, of two gentlemen who had taken a very prominent part in the agricultural development of the Island. He referred to Sir Marcus Fernando and Mr. C. Drieberg. Continuing, the Chairman said that the late Sir Marcus Fernando had been a member of the Executive Committee of the original Board of Agriculture and was a member of the Food Products Committee of that Board. He had also been a member of the present Board and of its Executive Committee. The late Mr. C. Drieberg, although not a member of the Board of Agriculture, had been associated with agriculture, under Government for nearly 28 years and his name would be remembered as the Secretary of the Ceylon Agricultural Society for many years until 1917 when the Society became absorbed in the Department of Agriculture. The Chairman then asked members to pass votes of condolence with the relatives of Sir Marcus Fernando and Mr. C. Drieberg. This was done in the usual manner, all members standing.

REPORT OF CHANGES IN MEMBERSHIP OF THE BOARD

The Chairman announced that the following changes had to be recorded since the last meeting of the Board :

Mr. E. L. Spencer-Schrader, elected by the Kurunegala District Agricultural Committee, in place of Mr. M. Prasad.

Mr. Rolf Smerdon having returned to the Island from leave resumes his seat on the Board in place of Mr. R. Neville Rolfe.

Mr. C. Huntley Wilkinson having returned to the Island from leave resumes his seat on the Board in place of Mr. A. J. McKee.

Mr. E. C. de Fonseka (Jnr.), who had been appointed to act for the late Sir Marcus Fernando, is to be confirmed in this appointment.

Mr. G. B. Foote having returned to the Island from leave resumes his seat on the Board in place of Mr. N. Bentley Buckle.

Mr. J. L. Kotalawala has been appointed to the Board in place of the late Mr. G. R. de Zoysa.

Mr. F. A. E. Price has been appointed to the Board in place of Mr. Gordon Pyper who has resigned.

Mr. A. A. Wickramasinghe has been appointed for nomination to the Board by the Kegalle District Agricultural Committee in place of Mr. H. D. Ditmas who has gone on leave.

The Chairman extended a welcome to the new members. He stated that a vacancy had been created on the Executive Committee of the Central Board

of Agriculture by the death of Sir Marcus Fernando and a successor would need to be appointed. The present members of the Executive Committee were: Messrs. D. H. Kotalawala, Rolf Smerdon, James Forbes (Jnr.), R. G. Coombe, C. E. A. Dias, K. Balasingham, Gate Mudaliyar A. E. Rajapakse, Mr. R. P. Gadiium and Mr. L. W. A. de Soysa. He called for nominations to fill the vacancy which had been created. The name of Mr. C. Hamilton Wilkinson was proposed by Mr. Wace de Niese and, on being seconded by Mr. C. E. A. Dias, the proposal was carried unanimously.

THE ESTABLISHMENT BY THE STATE OF A TOBACCO FACTORY IN JAFFNA

The Chairman stated that the motion regarding the establishment by Government of a tobacco factory in Jaffna, which stood in the name of Mr. C. Arulambalam, had been considered at the meeting of the Board held on May 9th but owing to lack of time on that occasion the motion had been postponed for further consideration at the present meeting. Before inviting discussion on the motion the Chairman enquired from Mr. Arulambalam whether he desired to amplify the views he had expressed when introducing the motion at the earlier meeting.

Mr. Arulambalam, in reply requested the permission of the Chairman to read extracts from an article which had appeared in the "*Times of Ceylon*" of May 13th, 1935, and which emphasized his own views as to the necessity of State aid being afforded to deserving industries. In the article referred to, it was pointed out that the new enthusiasm for industrial development in Ceylon was tending to impose upon Government duties which, in other countries, had been accepted by private enterprise. In Ceylon, however, facilities for industrial development were not readily obtainable and it was, therefore, the duty of the State to lead the way in such matters. The establishment of the Government soap factory in Mysore was an example of a State institution conducted on sound lines. The object of that undertaking had been to demonstrate that it was possible to produce an article of high quality and when this object had been achieved, private enterprise in Mysore had been stimulated to a marked degree. It was important however, that the intervention of the State in such matters should be limited to stimulating private enterprise and that there should be no attempt to interfere with, or compete against, such enterprise.

Continuing, Mr. Arulambalam pointed out that his motion included provision for the manufacture of cigars as well as of cigarettes and pipe tobacco. On further consideration he desired to exclude cigars from the scope of the motion as the question of improving the cigar manufacturing industry in Jaffna was already receiving attention in that district. He assured members that the resolution now before the Board had the support of the Jaffna District Agricultural Committee. In commending his resolution, which he desired to amend by deleting the word "cigars," for acceptance by the meeting, Mr. Arulambalam emphasised the fact that the tobacco industry in Jaffna had been in existence for over 325 years, the cultivation of the product in the peninsula dating back to 1610.

Mr. Wace de Niese seconded the resolution.

The Chairman stated that the need for improving the quality of tobacco grown in the Jaffna district so as to render it more acceptable to European and other markets was one which was recognised. The crop of White Burley grown last year was not considered to reach the standard demanded by European markets and steps were being taken to improve the cultivation of this and other types of tobacco. It had been the considered opinion of a former tobacco adviser to the Ceylon Government, Mr. Scherrffius, that the Jaffna district was not suited to the cultivation of cigarette tobacco but in spite of this opinion trials were to be commenced at the Jaffna Experiment Station with the best varieties of cigarette tobacco. If these trials proved to be satisfactory a flue curing shed would be erected in order to determine the quality of leaf which could be produced. The question of improving the quality of cigar tobacco was one which had already received the attention of the Department of Agriculture. Mr. Paul, the Divisional Agricultural Officer of the Northern Division, was now on a tour of the tobacco growing districts of India. His mission was to study the different types of cigar and other tobaccos grown in India and the conditions under which they were cultivated, with a view to introducing better types into the Jaffna district. He was due to return to Ceylon in the near future and his report should indicate the types of tobacco which might, with advantage, be introduced into this country.

Mr. Huntley Wilkinson suggested that the remarks made by Mr. J. C. W. Rock (Registrar-General and Director of Commercial Intelligence), when this subject was under discussion at an earlier meeting, might be read from the minutes of that meeting. He believed that Mr. Rock had suggested a course of action which should be followed if Mr. Arulambalam's resolution was accepted and he was of opinion that the procedure recommended by Mr. Rock should be followed. The Chairman read the relevant portion of the minutes of the meeting of the Board held on May 9th, 1935, which was as follows :—

> "As to the desire that the Industrial Adviser should report on the matter, the correct procedure he believed, was for the Board to pass a motion, which would be conveyed to the Minister of Agriculture, who would pass it on to the Ministry of Labour, Industry and Commerce, from whom it would come to him. It would be for him then to ask the Industrial Adviser to make the necessary investigation."

A general discussion followed and various suggestions were made by members with the object of extending the scope of the investigations contemplated in the motion before the Board. Finally, Mr. T. E. H. O'Brien suggested that the words "smoking tobacco" be substituted for the words "cigars, cigarettes and pipe tobacco," a suggestion which Mr. Arulambalam accepted. Mr. Arulambalam then proposed the following motion which Mr. Wace de Niese, who had seconded the original motion, agreed to in its amended form :

> "That with a view to encourage the tobacco industry in the Jaffna District—the staple agricultural industry of which is tobacco—this

Board recommends to Government to have an investigation made by the Industrial Adviser into the possibilities of opening a tobacco factory in Jaffna on up-to-date lines at State expense for the purpose of manufacturing smoking tobacco from the White Burley and other suitable types of tobacco cultivated in the Jaffna district, with a further recommendation to Government to have the factory established at an early date on getting a favourable report from its Industrial Adviser."

The motion was carried unanimously.

LEAFLETS ON AGRICULTURAL EDUCATION

The Chairman remarked that this subject had been discussed at the last meeting of the Board but that time had not permitted a decision being arrived at. He called upon Mr. Unamboowe to address the meeting.

Mr. Unamboowe said that his object in bringing this matter forward was to invite the Board to give greater publicity to the proceedings of the District Agricultural Committees and Divisional Agricultural Associations. He desired, further, that leaflets on important agricultural matters should be published and made available to these bodies.

The Chairman pointed out that leaflets on agricultural matters were already published by the Propaganda Division of the Department of Agriculture. Special funds would be required to give effect to Mr. Unamboowe's proposals.

In reply, Mr. Unamboowe stated that what he had in mind were leaflets on matters of general agricultural interest rather than of purely technical interest. He suggested that the co-operation of the press, particularly the Sinhalese press, might be of value in this connexion. Villagers possessed no facilities for reading the proceedings of their deliberations. If some steps could be taken to remedy this defect he would be satisfied.

Mr. Wilmot A. Perera agreed with Mr. Unamboowe's suggestion that the co-operation of the press should be sought and was of opinion that the "*Dinamina*" might be able to help towards the object they had in view.

Mudaliyar N. Wickramaratne suggested that the minutes of meetings might be published in "*Govikam Sangarawa*."

After further discussion Mr. James Forbes (Jnr.) proposed that :

"This Board accepts the principle of the wider dissemination of agricultural information and leaves the matter of such dissemination to the Department."

The motion was seconded by Mr. C. Huntley Wilkinson and carried.

THE DEVELOPMENT OF THE LIVESTOCK INDUSTRY IN CEYLON

The Chairman called upon Mr. M. Crawford, the Government Veterinary Surgeon, to read his memorandum on this subject.

Mr. M. Crawford said that the memorandum had been prepared on the instructions of the Hon'ble the Minister for Agriculture and Lands following the suggestion which he, the speaker, had made, that many of the difficulties experienced in developing animal husbandry were due to the very large number of interests which was involved and to the fact that there was no central body on which all these interests were represented and which could be consulted. As a result of that suggestion he had been instructed to prepare a memorandum for the consideration of the Central Board of Agriculture with particular reference to the advisability, or otherwise, of establishing such a permanent advisory body.

In his memorandum, Mr. Crawford emphasized the unsatisfactory state of the livestock industry in Ceylon at the present time. The basic reason for this condition of affairs was, in his opinion, the lack of remunerative outlet for the products of animal husbandry. Before any improvement in the situation could be expected, an increase in the utilization of the products of livestock breeding would be necessary and before this, in turn, could be effected the value of the products as articles of human diet would need to be impressed upon the people of the country. The most effective manner of bringing about the required changes in the traditional diet of the population, Mr. Crawford considered, would be to enlist the aid of the medical profession but this aim was unlikely to be fully realized without the further co-operation of the educational authorities as the chief effort would need to be directed towards the school children.

Mr. Crawford pointed out that although some effort had been made on the part of Government to afford assistance to breeders of livestock, much remained to be done. As instances of services which had been rendered to those engaged in the breeding of livestock he mentioned the introduction into Ceylon of new varieties of fodder and pasture grasses by the Agricultural Department, the demonstration by the Government dairy in Colombo that milk could be produced in the low-country at a profit, the importation of poultry of good utility type and the distribution of eggs and cockerels in the villages. The breeding of goats, both for meat and milking purposes, had been studied and a supply of pure bred Scind bulls for crossing purposes was available from the herd which had been maintained at Peradeniya since 1924. Surplus supplies of milk could now be utilized at the Manampitiya ghee depot which was founded about a year ago but although ghee of good quality could be produced, there was still some difficulty in finding a market for the produce.

With the object of improving livestock breeding in the villages certain small demonstration centres had been established where stud bulls were available as well as supplies of cheap eggs and of planting material of certain fodder grasses. In addition to these services, Government assistance was available in the form of control of infectious diseases and the total eradication of rinderpest from Ceylon is an instance of what has been done in this direction.

Among the more pressing needs of livestock breeders in Ceylon at the present time Mr. Crawford mentioned the following :— Suitable assistance

to those willing to import pure bred cattle of the European breeds ; better provision of stud bulls in the villages : development of distributing agencies for milk in the larger towns: facilities for transport of milk by rail over longer distances than is possible at the present time ; investigation of the possibility of converting patna lands into pastures and their development for dairying : improvement of marketing facilities for the products of livestock breeding : propaganda to encourage the use of milk products, eggs, poultry and meat as part of the daily diet ; removal of the restrictive regulations on the sale of cattle and the reduction of the prevalent practice of branding.

Mr. Crawford considered that the formation of a permanent body to deal with these problems would be of great value. To be effective all interests both official and unofficial, should be represented.

Before concluding, Mr. Crawford expressed the hope that some agreement would be arrived at by the meeting upon two points arising from his remarks. In the first place, it was necessary for members to decide whether, or not, they were in general agreement with his view that a central advisory body on animal husbandry was required. In the event of his view finding support the next step would be to decide upon the constitution of the proposed advisory body, and members might decide to proceed with the actual appointment of members or they might prefer to appoint a small sub-committee to consider the constitution of such a body. He expressed doubt as to the possibility of securing the full representation required within the limits of membership of the Central Board of Agriculture and it might be necessary to enlist the co-operation of those who were interested in special branches of the livestock industry but who were not members of the Board of Agriculture.

The Chairman summarised the main points of Mr. Crawford's address and invited the views of members on the subject. He considered that Mr. Crawford had put forward a convincing case in favour of the formation of a permanent committee to advise on the improvement of livestock in the Island and he was of opinion that the best way of giving effect to Mr. Crawford's proposals would be to appoint a small sub-committee, with power to co-opt other members who might be interested, and that this sub-committee should investigate the matter and report to the Board in due course.

Mr. R. P. Gaddum suggested that the matter should be referred to the Executive Committee of the Board which should have power to co-opt other members of the Board possessing special knowledge of the subject. The Executive Committe would then be in a position to make detailed recommendations to the Central Board at a later meeting.

Mr. F. A. E. Price was in agreement with Mr. Gaddum's suggestion.

Mr. Crawford emphasized the fact that the first point to decide was whether the advisory body suggested by him was necessary or not. He mentioned that a member of the Education Department was present and his views on the subject would be of interest.

Dr. R. V. Norris agreed with this view.

Mr. R. Patrick (Assistant Director of Education) said that he had attended the meeting in order to support Mr. Crawford in his idea of improving livestock and to say that his Department was willing to help in any possible way either by being co-opted or becoming members of any special committee. His Department was interested in this type of work being spread throughout the country. At the present time they had over a hundred schools where training in agriculture formed a great part of the school work. Every year this number was being increased. Already they had made good progress in paddy cultivation and vegetable gardening and they wished also to include in the work poultry-breeding and care of livestock. As a preliminary to this end the Teachers' Training Centre at Mirigama has obtained some cows from Mr. Crawford. The teachers were being trained to look after them, milk them, carry out cross-breeding and so on, so that when they went out to the schools, they would be able to start this work as soon as cattle were provided. Fodder grasses were being experimented with in practically all their schools and, in a short time, some of these schools would have a considerable area of ground under some suitable type of pasture grass. The only question that caused them concern at present was their ability to obtain livestock. They had received considerable help from Mr. Crawford already in obtaining poultry and cows, and they were ready to take over as many as he could provide. He would like to emphasize that, whatever was decided upon, his Department would give all the assistance possible.

Mr. Wilmot Perera said that the difficulty, to his mind, was in finding an outlet for the surplus milk. Until Government subsidised schools to enable them to make use of surplus milk, he feared little headway would be made in the matter. The Medical Department's interest in the proposal could be easily secured. There was a good deal of talk to-day about malnutrition in the country, and one way of correcting it would be to provide every school child with a glass of milk daily. He believed that the English Maternity and Child Welfare Ordinance made provision for local government authorities to provide milk in necessitous cases, the recipients pay for it on a sliding scale based on income, so that the very poor paid nothing at all. Another aspect of the matter which should be considered was that of thefts of cattle. It was not so much the improvement of cattle in some areas that was necessary as that of preventing their being lifted.

After further discussion the following resolution, proposed by Mr. James Forbes (Jnr.) and seconded by Mr. Wace de Niese, was adopted :—

> "This Board accepts the principle of the formation of a permanent advisory committee on animal husbandry, such committee to be representative of all interests, both official and unofficial, in the country, and that the matter be referred to the Executive Committee to see how effect can best be given to this decision."

THE IMPROVEMENT OF COCOA CULTIVATION AND MARKETING OF COCOA

The Chairman said that this subject, which had been postponed from the meeting held on 19th September, 1935, stood in the name of Mr. P. B. Ranaraja who was not present that day and he suggested that the matter

be postponed. At the same time, he would like to read the resolution which had been passed by the Kandy District Agricultural Meeting on 6th July, 1935, and which had been referred to the Central Board of Agriculture for consideration. The resolution was as follows :—

> "That it is the opinion of this association that Government be requested to take adequate steps to improve the local cocoa cultivation and market for cocoa."

Continuing, the Chairman said that the Department of Agriculture had studied the matter closely and had prepared a leaflet on the fermentation and curing of village cocoa. This had been published in the December number of "*The Tropical Agriculturist*," and also printed as a leaflet in the vernacular, and circulated in the cocoa districts. As regards marketing, he said that that matter was in the hands of the Marketing Commissioner and a start had already been made in parts of the Katugastota District. The matter would be developed from the start of the next cocoa season.

THE COCONUT CATERPILLAR PEST IN THE BATTICALOA DISTRICT

The Chairman stated that two questions, asked by Mr. S. Armstrong, had appeared on the agenda of the last meeting of the Board but that lack of time on that occasion had prevented answers being given to Mr. Armstrong Mr. Armstrong had been unable to attend the present meeting but he considered that certain information on the subject should be given to the meeting. Mr. Armstrong's first question was as follows :—

> "Will the Government Entomologist be pleased to inform this Board as to what steps are being taken to breed the parasites to control the coconut caterpillar pest in the Batticaloa District and whether the breeding of the parasites is to be started shortly, and if so how long would the breeding have to be done to effectively control the pest which is found to be never absent from this District."

In reply to this question the Chairman said that it had been known for some years that an Eulophid parasite of coconut caterpillar (*Nephantis serinopa*) exercised a controlling influence on this pest in South India, and to a lesser extent in Ceylon. In Ceylon, the parasite had been limited to the Western and North Western portions of the Island and was believed to have played an important part in preventing, or reducing, serious outbreaks of coconut caterpillar in the coconut areas of these regions. It had not, however, penetrated to the Eastern Province, and earlier attempts, on a small scale, to effect its artificial introduction into the province had not been successful.

During recent years the pest had been so little in evidence in the coconut areas of Ceylon, outside the Eastern Province, that it had not been possible to obtain specimens of the parasite locally. Meanwhile, the pest, favoured by the dry weather experienced during the past two years, had caused considerable damage in the Batticaloa district. Certain other parasites which were known to occur in that district were unable to check the spread of the pest or to keep it under control, and arrangements were made early

in 1935 to attempt the introduction of the Eulophid parasite, *Trichospilus pupivora*, from South India. It was not until November last that material from India became available, and, in anticipation of the arrival of the parasites, host material of coconut caterpillar and paddy swarming caterpillar was bred at Peradeniya.

A small consignment of parasites arrived from India on November 22 and gave rise to parasites immediately after arrival. The pupae of coconut caterpillar were offered to the parasites and on December 2 an officer of the Entomological Division left for Batticaloa with this freshly parasitised material. A special insectary had been constructed at Batticaloa, and arrangements concluded for the raising of host material in sufficient quantity, prior to the importation of the parasites from India, and a promising start had been made in propagating the parasites.

The number of parasites received from India was 650. These gave rise, during December, to a first generation of 1,430 individuals, which in turn produced 7,600 of the second generation. The third generation was expected to appear about January 22. Of the parasites produced in Ceylon to date, which numbered approximately 10,000, nearly 8,000 were liberated in areas where coconut caterpillar was still to be found in the Batticaloa district, the balance being retained for raising further stocks. Simultaneously, the parasite was being bred at Peradeniya in small numbers, in case any misfortune befell the Batticaloa strains.

At the present time, the prevalence of coconut caterpillar in the Eastern Province has so decreased following the rains that it was difficult to find living specimens of the insects in the open. The breeding of the parasites would, however, be continued on a smaller scale until the pest reappeared, when the output would be increased to the utmost capacity of the staff available. As dry weather favoured the development of the pest and was considered to be unfavourable to the natural development of the parasite, the final success of this venture remained to be seen, but the possibility of success had justified the experiment being undertaken.

The second question asked by Mr. Armstrong was as follows :—

> " In view of the wilting of the bud and the crown of the coconut trees owing to unusual drought, is it absolutely necessary to cut off the coconut leaves affected by the caterpillar pest, and give effect to the Plant Protection Ordinance, which was introduced to control such pests at a time when the biological control of these pests was not contemplated ?"

In answer to this question the Chairman stated that in view of the drought during the last year or two, malaria and other economic conditions, instructions were issued to the Divisional Officer in the Batticaloa district not to enforce the cutting and burning of leaves. These instructions were given prior to the introduction of the parasites. In view of the liberation of parasites in areas where coconut caterpillar occurs in the Eastern Province, the Chairman stated that it was not intended to enforce the provisions of the regulations made under the Plant Protection Ordinance as such action would

deprive the parasites of their hosts and thus prevent their establishment in the district. Further instructions were to be issued to that effect.

BETTER CONTROL OF VILLAGE FAIRS

The Chairman said that this item had been postponed from the last meeting and he called upon Mr. Wilmot Perera to speak on this subject.

Mr. Wilmot A. Perera moved :

> "That this Board recommends to Government that the Marketing Commissioner should cause an investigation to be made into the possibility of controlling the growth of village fairs."

Mr. Perera said that what happened now was that somebody had a brain wave and started a fair going. Of course a levy was made that was the object behind it. There was no control of the levy and no check on the weights and measures used. It was a matter in which they were up against village vested interests.

Mudaliyar N. Wickramaratne agreed that village fairs, other than those that came under local governing bodies were organised by rivals. He thought that, in this matter, something could be done by departments under the Minister for Agriculture with the co-operation of Revenue Officers.

Mr. E. L. Spencer-Schrader seconded the motion.

Mr. J. L. Kotalawala said that if there was any freedom to hold fairs now the proposed control would be a reactionary step in that such control might prove tyrannical.

The Chairman said that he was not sure that this was a matter for the Marketing Commissioner.

Mr. Wilmot Perera said that he had no objection to the word "Government" being substituted for the words "Marketing Commissioner." In any case, the Minister would refer the matter to the appropriate authority.

The motion, as proposed, was carried.

CLERICAL ASSISTANCE FOR SECRETARIES OF DISTRICT AGRICULTURAL COMMITTEES

The Chairman mentioned that this item, which stood in the name of Mr. Wilmot A. Perera, had been postponed from the last meeting and he called upon Mr. Perera to introduce the subject.

Mr. Wilmot A. Perera said that this matter, was perhaps, an administrative one but he thought that it could come within the scope of this Board as it was so inter-related with agricultural development. He thought that with the organization of Divisional Agricultural Associations and District Agricultural Committees a considerable amount of clerical work had to be done by Divisional Agricultural Officers. Although Divisional Agricultural Officers were solely field officers their time was much taken up in attending to all the correspondence of Divisional Agricultural Associations and District Agricultural Committees. He instanced the case of the South Western Division as this was the one in which he happened to reside. There, the

Divisional Agricultural Officer had to attend to the correspondence of three District Agricultural Committees and eighteen Divisional Agricultural Associations. What he actually desired in this connexion was an expression of opinion from the Board.

The Chairman said that the only possible way of meeting this situation would be to provide permanent clerks. He thought that this matter would have to be taken up in next year's estimates.

Mr. Wilmot A. Perera said that if the Chairman gave him that assurance it would be sufficient.

CITRONELLA RESEARCH

The Chairman invited Mr. Montague Jayawickreme to move his resolution on this subject.

Mr. Montague Jayawickreme moved :

> " That this Board considers that any citronella research investigations undertaken at Labuduwa should be discontinued immediately since the locality is considered to be unsuited for the normal cultivation of citronella grass and that an experimental station should be established in the heart of the citronella district in terms of the motion on this subject passed unanimously on November 8, 1934, by this Board."

Mr. Jayawickreme said that when he moved the motion on November 8, he placed before the Board information to show that citronella was an important product and that, though 40,000 acres were under cultivation in citronella, nothing had been done in the way of scientific research to help the industry. In seeking modification of the policy of the Department of Agriculture with regard to citronella he indicated the possible directions in which investigations might be made, such as selected plants, the use of green manure and low and high shade. He assumed that certain undertakings given by Dr. Youngman would be carried out. All that had been done so far was that a few acres of citronella were being cultivated at Labuduwa. Citronella was a dry zone crop. It was cultivated for the market in an area running into 40,000 acres in a part of the country where the average rainfall was 60 inches. The experiment station of the Department of Agriculture, members would be amazed to hear, was situated in a place where the average rainfall was 100 inches. It was the view of the late Director that preliminary investigations should take place at Labuduwa. In his own view it was analogous to growing sisal hemp at Peradeniya. And it was expected to disseminate the results of the investigations at Labuduwa to villagers !

Having some practical and theoretical knowledge about the crop he would ask the Department to consider certain recommendations which he had made in conjunction with those made by the Divisional Agricultural Officer, who thought Labuduwa was the worst possible place for citronella experiments.

The Chairman stated that the matter had been taken up recently by the Economic Botanist in collaboration with the Agricultural Chemist and that the desirability of acquiring a piece of land in the Matara district was under

consideration. He quite appreciated Mr. Jayawickreme's point about Labuduwa not being quite suitable. He thought that it was important to have experiments conducted in the main citronella district. As soon as the land was acquired the matter would be considered further. He called upon Dr. Haigh to explain what could be done in the way of investigation.

Dr. J. C. Haigh said that he agreed with Mr. Jayawickreme that the best results would be obtained from work on any crop when that work was carried out on plants growing in their proper habitat, and he agreed, therefore, that the Department should have an area of land in the Matara district on which citronella should be grown and on which experiments could be carried out. He did not agree, however, that the research work contemplated at Labuduwa should be discontinued immediately, and for the following reasons :

Firstly, the transfer of investigations to another centre would involve the uprooting of the varietal plots at Labuduwa and their establishment elsewhere, resulting in a delay of at least a year. This would only be justified if the work contemplated at Labuduwa was of no value. Labuduwa, although not actually in the citronella country, was on the outskrits of it and was not entirely unsuited to its cultivation. The programme of research was based, not on the yield of oil, but on the geraniol content of the oil, and available evidence showed that it was extremely unlikely that a hereditary character such as geraniol content would be altered by a comparatively slight change such as that from Matara to Galle. Yield would undoubtedly vary, the percentage of oil in the leaves might vary, but the geraniol content of the oil should not.

Secondly, the actual programme of improvement included periodic analyses of grasses by the Agricultural Chemist, and it was intended that a member of his staff should visit Labuduwa at crop time and carry out analyses on the spot. This would demand laboratory accommodation, which could be made available at Labuduwa but could not be provided elsewhere.

Thirdly, and perhaps most important, it had been determined that the oil in the Citronella plant was carried in special cells of the leaf. It was proposed to carry out, at the same time as the leaves were being distilled to determine their geraniol content, a microscopic examination of sample leaves to determine whether there was any correlation between the number and size of these special cells and the geraniol content of the leaf. If there should prove to be a positive correlation, future test distillations would be unnecessary, and a botanical examination of sample leaves would suffice to indicate potential high-yielding plants. The expense of erecting costly distilling apparatus on the new area, when it was established, might thus be saved.

Having by one, or other, of these methods determined the most valuable plants, they could be grown under a variety of conditions in the optimum environment and it could be determined which cultural treatment would give the highest yield per acre.

Mr. Wace de Niese seconded the motion. He suggested to the mover that it would serve his purpose if the words " any investigations undertaken at Labuduwa should be discontinued " were omitted. He did not think, he

said, that Mr. Jayawickreme cared about what experiments were being conducted at Labuduwa. Mr. Jayawickreme was desirous of having an experimental station at Matara, and the Chairman had indicated that that was to be done.

The Chairman assured Mr. Jayawickreme that investigations were proceeding as rapidly as possible. Citronella investigation was first started by Mr. Simpson, Systematic Botanist, a few years ago, but owing to the depression his post was abolished and the investigation had to be stopped. It was only recently that it had been possible to start again. If further staff could be provided it would be possible to proceed more rapidly.

Mr. Jayawickreme thanked the Chairman for his attitude in the matter. As regards Dr. Haigh's view that geraniol content would not be altered at Labuduwa, Mr. Jayawickreme said that samples examined by the Agricultural Chemist some years ago showed remarkable difference in geraniol content in the samples from Beliatta where the rainfall was 100 inches and Tangalle, where the rainfall was 60 inches. The geraniol content in the Beliatta samples was 58 per cent. and in the Tangalle samples 68 per cent. So that Dr. Haigh seemed to be expounding a hypothesis. Mr. Jayawickreme was certain there would be a difference in the geraniol content of the same variety grown at Labuduwa and in the citronella country. It was entirely due to the climatic factor that the plantations in Baddegama belonging to Mr. Winter, a pioneer of citronella in Ceylon, ceased to exist. He was convinced that the investigations at Labuduwa would serve no useful purpose and should be stopped.

Mr. C. E. A. Dias said that when the Soil Erosion Committee went to Labuduwa in 1929 they considered this Experiment Station was a "white elephant." He believed, from what he had heard, that they were now trying to make some use of the place.

Mr. Dias moved the amendment suggested by Mr. de Niese.

In reply to Mr. Jayawickreme Dr. Haigh said that Mr. Jayawickreme may have sent plants of the same species but geraniol content varied not only for species to species and variety to variety but from plant to plant. It would be very optimistic to say that because six plants from Matara gave a higher geraniol content therefore six plants from Labuduwa would have their geraniol content affected by environment. It required analyses on a much larger scale to establish such a claim.

Asked if he had any comments to make, Dr. A. W. R. Joachim (Agricultural Chemist) said he agreed with Dr. Haigh that geraniol content might vary from plant to plant and not only from species to species. In the arrangements for investigations in citronella that had been drawn up it was proposed to analyse each plant separately with a view to deciding which were high-yielding, not only from the point of view of oil content but of geraniol content. It might mean numerous analyses but it was the only way of discovering plants with high-yielding geraniol contents.

Mr. Jayawickreme accepted the amendment moved by Mr. Dias and the following amended motion was adopted :—

> "This Board considers that an experimental station should be established in the heart of the citronella district."

REDUCTION OF RENT ON MIDDLE CLASS AND NINETY-NINE YEAR LEASEHOLDS

The Chairman called upon Mr. Montague Jayawickreme to speak on this subject.

Mr. Montague Jayawickreme said that the following motion had been referred to him by the District Agricultural Committee of Matara :—

> "That Government should consider the desirability of reducing the rent on the middle class and 99 year leaseholds in view of the fact that terms and rates were fixed before the depression."

The main reason for this step was he said, that commodity prices had fluctuated greatly since the rates were fixed and it was very difficult for present proprietors and middle class landholders to pay the amounts due. He understood that representations had recently been made by certain associations on this subject. He desired to bring the matter to the notice of the Board on instructions from his committee, but he did not wish to propose a definite motion.

Mr. Wilmot A. Perera suggested that perhaps Mr. Kotalawala could give members some information on the subject. The Minister of Agriculture had made a certain statement in regard to a resolution passed by the Kalutara Committee.

Mr. J. L. Kotalawala replied that the Minister would need to know whether the land was cultivated in rubber, tea, etc., and what was the nature of the lease. If this matter came under the present Land Development Ordinance a "middle class man" was one whose income was Rs. 600·00 per annum. He did not know what district was referred to by Mr. Jayawickreme. If he referred to all districts, the Land Development Ordinance laid down that each advisory committee should fix the rate.

Mr. Jayawickreme said that he was not present at the meeting held at Matara when this matter was discussed. He had been asked to bring this up before the Central Board in a letter dated 30th October, 1935, which he received from the Secretary, Matara District Agricultural Committee. The motion was submitted by the Mudaliyar of Weligam Korale, at the meeting of the Matara District Agricultural Committee held on the 16th October, 1935.

Mr. A. C. Attygalle enquired whether Advisory Boards were not constituted to consider future leases.

Mr. Wilmot A. Perera replied that to the best of his knowledge the Minister had undertaken to consider cases brought to his notice.

Mr. J. L. Kotalawala stated that this had been done.

Mr. Jayawickreme again stated that he did not desire to press the resolution and the matter was then dropped.

The Chairman proposed that owing to the lateness of the hour the rest of the items on the agenda be deferred for consideration at the next meeting.

Mr. Wace de Niese seconded.

The meeting terminated at 4·55 p.m.

F. P. JEPSON,
Acting Secretary,
Central Board of Agriculture.

MEMORANDUM ON THE DEVELOPMENT OF LIVESTOCK INDUSTRY IN CEYLON

M. CRAWFORD, M.R.C.V.S.,

GOVERNMENT VETERINARY SURGEON

FOR many years past the poor standard of livestock in Ceylon has been deplored, many causes have been assigned and suggestions made for improvement. Committees have been appointed from time to time and have made recommendations, but unfortunately it cannot be claimed that much progress has been made. A feature of past efforts has been that they were spasmodic there was no continued effort carried on over a period of years. Improvement in this respect could probably be obtained if there was in existence some permanent body interested in the subject and in a position to stimulate, lead and maintain public interest.

The livestock industry in Ceylon is at such a low level that the efforts to improve it will have to start from fundamentals, they will have to be broad-based since this problem touches the lives of the people at many points, and above all will require the united efforts of a team of workers.

To my mind the basic reason for the unsatisfactory state of livestock in Ceylon is to be found, in the lack of a remunerative outlet. There is no remunerative outlet for the simple reason that the products of animal husbandry are not articles which are in common use among the bulk of the population. If any great increase in the breeding of livestock is to take place there will have to be at the same time a great increase in the utilisation of the products of livestock breeding. This will require widespread propaganda on the value of these products as articles of human diet and the desirability of including them as part of the daily food.

For such propaganda to be of value it would require the support or backing of the Medical profession. It will be a difficult matter to affect changes in the traditional diet of the adult section of the population, and probably the chief effort will have to be directed towards the school children. In this work the co-operation of the Educational authorities will be necessary.

There is a tendency to consider that animal husbandry presents the same set of problems in all parts of the country and that the same measures for encouragement will be applicable.

This is far from being the case. For example the problems facing the man who breeds cows of the European milking breeds in the up-country districts are very different from those encountered by the villager owning cattle in the Dry Zone which again are different from those presented to the man who breeds goats for sale to the butcher and so on. This being the case it

is of value to state exactly what is being done at present to help the various sections into which the livestock industry could be divided and more important still to consider what sections have been neglected and require aid.

Government assistance to livestock breeders at present might be summarised as follows :—

The Agricultural Department obtains new varieties of fodder grasses and pasture grasses, tests them for their suitability to Ceylon conditions and if found suitable makes planting material available to the public. This work has been going on for many years and is still being continued. As a result of this work several excellent types of fodder grasses are available today and are widely grown.

The same degree of success has not yet been obtained in regard to pasture grasses and we are still without a really satisfactory pasture grass. However, new varieties are continually being tried and it is hoped that one or more will eventually be available.

Paspalum dilatatum has proved to be a good grass which does very well at the higher elevations and is widely grown up-country but so far it has not been a success in the low-country.

A practical demonstration of a system of dairying suitable for the supply of milk to Colombo has been offered for many years by the Government Dairy, Colombo.

This dairy is eminently practical and is run at a profit. It demonstrates that milk can be produced in the low-country and that at existing price levels for milk a handsome profit can be earned.

The possibilities of poultry farming have been studied at Peradeniya and at Ambepussa, and birds of good utility type have been imported. From these places eggs and birds have been sold and a considerable number of cockerels have been issued free during recent years for improvement of village poultry. Poultry are also kept at the Experimental Farms of the Department of Agriculture in various districts.

The breeding of goats for the butchers has been studied under low-country wet zone conditions at Ambepussa in recent years.

A beginning has just been made at the Government Dairy in the breeding of milch goats.

A herd of pure bred Scind cattle has been maintained at Peradeniya by the Agricultural Department since 1924. It was started in a small way but has now grown considerably and is becoming useful as a source of supply of Scind bulls for crossing purposes.

The first attempt at utilisation of such supplies of surplus milk as are available in the Tamankaduwa District has been made at the Ghee Depot started at Manampitiya nearly a year ago. At this depot milk is purchased from villagers who bring it in daily and converted into ghee. The ghee is sold in Colombo. Good quality ghee has been prepared with very simple apparatus but a certain amount of difficulty has been experienced in finding a market.

With the object of improving livestock breeding in villages small centres have been started at a number of places. These centres are intended to act as demonstrations of improved methods which are within reach of the villager. The type of cattle sheds, poultry houses, etc., is of the simplest and only materials readily available in the villages are used. Stud bulls are kept and are available to the villagers. A pen of poultry for supply of cheap eggs is maintained. Fodder grasses are cultivated and material for planting is available. These centres are just beginning.

The first one was at Nikaweratiya, others are being started at Veyangoda, Murungan in the Mannar District, and Akkaraipattu in the Eastern Province. It is too early yet to say whether these centres will prove successful. The principle on which they are being worked is that the methods used should be such as the villager with his limited financial resources can imitate. The cows and goats are of the village breed and it is hoped to demonstrate how the type can be improved by feeding and the use of better stud bulls. At these places it is intended to demonstrate the value of cattle manure, etc., especially when converted into compost. The officers in charge of these centres are in a position to carry on propaganda in the neighbouring villages and to demonstrate methods of castration.

The centre which is started at Murungan in the Mannar District is intended primarily for encouragement of goat breeding.

In addition to these special efforts Government assistance is available in the form of control of infectious disease. The greatest success which has been obtained in this direction is the total eradication of rinderpest from Ceylon.

Advice is available on application. Demonstrations, lectures and talks are given.

So much for what is being done.

Some of the more urgent needs at present are as follows :—

(1) Some form of assistance to those willing to import pure bred cattle of the European breeds to maintain the standard of the up-country cattle which are the chief source of supply for the town dairies. Freight rates are so high that few people can afford to import.

(2) Provision of stud bulls for use in villages. The supply available is very small and it will probably be necessary to import from India. To enable this to be done a new Quarantine Station at Trincomalee is projected.

(3) Development of a distributing agency for milk in the larger towns. Nothing of this sort exists in Ceylon. All producers of milk have to make their own arrangements for distribution. The result is that all the dairies are situated either actually within the towns or very close to them. If an efficient agency for receiving and retailing milk existed, the radius from which the milk supply of a town is drawn could be greatly extended.

(4) Facilities for transport of milk by rail over longer distances. Modern methods of refrigeration or pasteurization render transport of milk possible over very considerable distances. There is the possibility that the milk supply of the towns could be considerably augmented from up-country areas if facilities existed for safe transport.

(5) Investigation of the possibility of converting patna lands into pastures so that the district where patna lands are extensive might be developed for dairying.

(6) Improvement of marketing facilities for such products as eggs, poultry, sheep, goats and cattle.

(7) Propaganda to encourage the use of milk products, eggs, poultry, meat and mutton as part of the daily diet.

(8) Removal of restrictive regulations on the sale of cattle.

(9) Reduction of the all too prevalent practice of branding.

These are only some of the more urgent needs.

The formation of a permanent body to discuss these problems, maintain public interest, advise on the best methods to be adopted and co-ordinate the various activities will in my opinion be of great value.

I suggest that such a body could be constituted as a sub-committee of the Central Board of Agriculture with the assistance of representatives of the Medical and Education Departments and persons competent to represent the views of poultry farmers, goat breeders, etc.

The following interests should be represented : on the official side—Agricultural, Education, Medical, Marketing and Veterinary ; on the unofficial—Poultry farmers, goat breeders, breeders of cattle on coconut Estates, owners of dairies supplying milk to the large towns, breeders of goats for sale to butchers, up-country breeders of cattle of European breeds, owners of village cattle, etc.

RUBBER RESEARCH SCHEME (CEYLON)

Minutes of the thirtieth meeting of the Board of Management, held in the Committee Room of the Ceylon Chamber of Commerce, Colombo, at 10 a.m. on Thursday, 12th December, 1935.

Present.—Dr. J. C. Hutson (in the chair), Mr. C. H. Collins, C.C.S., (Deputy Financial Secretary), Messrs I. L. Cameron, C. E. A. Dias, J.P., L. B. de Mel, J.P., U.P.M., George E. De Silva, F. H. Griffith, Col. T. G. Jayewardene, V.D., Messrs J. L. Kotalawala, C. A. Pereira, E. W. Whitelaw and Col. T. Y. Wright.

Mr. T. E. H. O'Brien, Director of Research, was also present by invitation.

Mr. M. W. Philpott, Chemist, was present until conclusion of the discussion on rubber flooring compositions was completed.

Apologies for absence were received from Messrs R. Neville Rolfe, E. C. Villiers and L. P. Gapp.

MINUTES

Draft minutes of the twenty-ninth meeting which had been circulated to members were confirmed and signed by the Chairman.

BOARD

The Chairman reported that Mr. E. W. Whitelaw had been re-nominated by the Rubber Growers' Association as one of its representatives on the Board for a further term of three years from 14th December, 1935.

SULPHUR DUSTING SCHEME

The Chairman reported that a grant of Rs. 20,000·00 from the Rubber Restriction Fund had been allotted for the purpose of carrying out the scheme of sulphur dusting in the Central Agricultural Division. Arrangements for the work were being made by Mr. W. I. Pieris with the co-operation of the Department of Agriculture. It was decided to issue an advertisement stating that preference in the selection of areas for dusting, would be given to Proprietors who were prepared to contribute towards the cost of the work on the following basis :—

Small estates (10-100 acres)	.. ..	Rs. 2·50 per acre
Small-holdings (less than 10 acres)	..	,, 1·00 ,, ,,

RUBBER FLOORING COMPOSITIONS

Specimens of tiles and flooring material in sheet form, made from rubber and coir waste mixtures on the experimental machinery at Dartonfield, were inspected. Proposals were considered for the installations of larger

machinery for trials of the process on a semi-commercial scale. It was decided to obtain a report on the proposals from the Government Electrical Department before taking further steps.

STAFF

Mr. T. E. H. O'Brien's Agreement.—Terms of re-engagement were decided on.

Mr. W. I. Pieris' Agreement.—Terms of the agreement were approved and the Chairman and Mr. C. H. Collins were asked to authenticate the Board's seal on the document.

Junior Staff.—Changes in Clerical Staff were reported.

Travelling Allowances.—It was decided to pay mileage allowances on a flat rate basis instead of following Government scales of payment, with effect from January 1, 1935.

Rent Allowances, Junior Staff.—It was decided to pay rent allowances to officers for whom quarters are not provided, on the following scales, with effect from January 1, 1935:

Married Officers	10% of salary
Unmarried Officers	7½% „ „

APPOINTMENT OF SOIL CHEMIST

A proposal for the appointment of a soil chemist was considered in relation to the financial position of the Scheme. Several members stressed the importance of work on soil problems being undertaken without delay and it was decided to make an appointment as soon as the financial position permits.

TRANSFER OF HEADQUARTERS TO DARTONFIELD ESTATE

In view of the arrangement to transfer the headquarters of the Scheme to Dartonfield towards the end of 1936 it was decided to give 12 months' formal notice to terminate the lease of buildings at Culloden Estate.

COCONUT RESEARCH SCHEME

BOARD OF MANAGEMENT

Minutes of the thirtieth meeting of the Board of Management of the Coconut Research Scheme, held in Room No. 202, New Secretariat Building, Colombo, on Friday, December 13, 1935, at 11 a.m.

Present.—Dr. J. C. Hutson, (Acting Director of Agriculture), (in the chair). Mr. C. H. Collins, C.C.S., (Treasury Representative), Messrs J. L. Kotalawala, Austin Ekanayake, Gate Mudaliyar A. E. Rajapakse, O.B.E., Messrs A. W. Warburton-Gray, J.P., U.P.M., G. Panditteseker, J.P., U.P.M., Wace de Niese, D. D. Karunaratne, J.P., and Mr. W. V. D. Pieris, Officiating Chief Technical Officer, who acted as Secretary. An apology for absence was received from Mr. L. W. A. de Soysa.

MINUTES

The minutes of the twenty-ninth meeting of the Board of Management, held on September 27, 1935, copies of which had been circulated were confirmed by the Board and signed by the Chairman.

NOMINATIONS TO THE BOARD OF MANAGEMENT

The Chairman reported that (*a*) His Excellency the Governor had been pleased to re-nominate Mr. F. A. Obeyesekere as a representative of the State Council on the Board of Management for a further period of three years commencing on November 1, 1935; (*b*) the Low-Country Products Association had nominated Mr. Wace de Niese to represent that body in the place of Sir H. Marcus Fernando, whose membership had lapsed according to section 8, First Schedule to Ordinance No. 29 of 1928; (*c*) Gate Mudaliyar A. E. Rajapakse, whose membership had lapsed according to the same section, had been re-nominated by the Low-Country Products Association.

The Chairman welcomed Mr. Wace de Niese.

FINANCE

(*a*) The Statement of receipts and payments for the third quarter ended September 30, 1935, which had been circulated was endorsed.

SUPPLEMENTARY ESTIMATES FOR 1936

(*b*) *Telephone.*—The Chairman explained that, since it was necessary to maintain telephonic communication with the Scheme outside office hours, the extension telephone had been removed from Dr. Child's bungalow, which was at present unoccupied, and installed in the Geneticist's bungalow at a cost of Rs. 24·50. This amount was passed as a supplementary vote.

Estate : General Charges.—A supplementary vote of Rs. 150·00 was passed.

Upkeep of Buildings.—A supplementary vote of Rs. 150·00 was passed.

(c) *Fixed Deposit.*—The Chairman reported that the Government Grant of Rs. 30,000·00 had been paid to the Scheme by the Treasury on November 8, 1935, and that Rs. 20,000·00 out of that amount had been placed on Fixed Deposit for one year from November 13, 1935, and Rs. 10,000·00 in current account. The Chairman stated that the amount in Fixed Deposit was now Rs. 100,000·00.

The action taken by the Chairman in connection with the grant was endorsed.

ESTATE

Mr. Warburton-Gray drew attention to the fact that husks and leaf-butts were being sold off the estate when a definite resolution had been passed by the Board prohibiting such sales. Mr. Pieris stated that although a certain quantity of husks could be used for burying in trenches and for mulching, it was not possible to utilise all the husks for these purposes and that, therefore, the Chief Technical Officer had used his discretion and disposed of the husks of certain picks. He also stated that husks were not sold unless the prices obtained for them compared well with their manurial value. The Board decided that Mr. Pieris should report further on this matter at the next meeting.

The Estate Progress Reports for the months of September and October, 1935, which had been circulated to members, were passed. Mr. Pieris was asked to furnish, in future, details of sub-head "Contingencies" (General Charges, sub-head 5).

COPRA KILN

The Board next proceeded to discuss the Joint Report submitted by Mr. Pieris and the Registrar-General and Director of Commercial Intelligence on the problems connected with the curing and marketing of village copra. The main points discussed in the Joint Report were :—

1. The improvement of village copra by means of improved kilns and better methods of drying.
2. The establishment of buying centres for village copra.
3. The establishment of centres for buying and curing villagers' nuts.
4. The appointment of Small-holdings Officers to undertake propaganda among villagers.

The Chairman stated that since the circulation of the report, Mr. Pieris had convened a meeting at Bandirippuwa Estate of the more prominent local villagers and others interested in the project to discuss the recommendation made in the report that a copra curing centre should be established at Bandirippuwa Estate.

After some discussion, it was decided that the Coconut Research Scheme should not undertake work of the nature outlined in the Joint Report, chiefly since the Coconut Board was contemplating work on similar lines ; but that inquiries should be made from the Registrar of Co-operative Societies and the Marketing Commissioner regarding the usefulness of a gift of three kilns, situated in three different coconut growing areas, to be made to the Co-operative Societies in these areas.

It was decided that the appointment of Small-holdings Officers should be left to the Coconut Board.

JUNGLE AREA FOR NURSERY WORK

The Chairman stated that investigations on jungle land for experimental work had been going on since September 1931, and drew the attention of the Board to Circulation Paper No. 189 containing a summary of these investigations. He pointed out that out of the eight jungle areas examined only two were found to be suitable, namely Elapahalakelle Crown Jungle and two Jungle Blocks attached to Ratmalagara Estate. There followed a general discussion on the advantages and disadvantages of these two areas. The Chairman also stated that the two jungles were situated at about the same distance from Bandirippuwa Estate.

It was finally decided that the Chairman should make further enquiries regarding the availability of these two areas.

EXPERIMENTAL : MANURIAL EXPERIMENTS ON BANDIRIPPUWA ESTATE

Mr. Warburton-Gray inquired why a more extensive programme of manurial experiments and cover cropping experiments had not been taken in hand. Mr. Pieris, replying, referred to the fundamental manurial experiment which had been laid down on Bandirippuwa Estate, details of which had been circulated to members, and went on to state that owing to the lack of uniformity of soil conditions on Bandirippuwa Estate, the Soil Chemist had stated that it was not possible to lay down more than one experiment of the type referred to in the Circulation Paper. That experiment utilised about one-fifth of the total acreage of the estate, but the remaining four-fifths could not be utilised for experiments with fertilisers and cover crops on the same lines. Such experiments would have to be carried out in co-operation with owners of private estates. Bandirippuwa Estate could, however, be used for growing demonstration plots of cover crops, for extensive yield-recording and other straight forward work.

After some discussion, Mr. Warburton-Gray proposed that a scheme regarding manurial experiments should be drawn up and circulated to Board Members. Mr. Ekanayake seconded. The motion was carried.

MISCELLANEOUS

Among other miscellaneous subjects discussed was a proposal that, owing to the length of the agenda, the Board should consider the feasibility of appointing a Finance Sub-committee. After some discussion, it was decided that meetings should be held more frequently than once a quarter if possible, and that minor matters should be decided by the circulation of papers to Board Members.

The Chairman read a letter dated October 29, 1935, from the Hony. Secretary, Chilaw Planters' Association requesting permission to use the Coconut Research Scheme Library as one of the meeting places for that Association. The Chairman stated further that granting this permission would be useful to establishing further contacts between officers of the Scheme and coconut planters in the Chilaw district. The Board agreed to allow the Chilaw Planters' Association to hold one meeting a year in the Coconut Research Scheme Library.

The Chairman reported that Mr. W. V. D. Pieris had been granted permission to be co-opted a member of the Standing Committee of Industrial Research and Development, in the place of Dr. Child.

The meeting adjourned at 1·30 p.m.

TEA RESEARCH INSTITUTE OF CEYLON

Minutes of the Meeting of the Board of the Tea Research Institute of Ceylon, held in the Ceylon Chamber of Commerce rooms, Colombo, on Saturday, the 11th January, 1936, at 10·30 a.m.

Present.—Mr. James Forbes (Jun.), (Chairman, T.R.I.), The Hon'ble the Financial Secretary (Mr. H. J. Huxham), Messrs I. L. Cameron, R. G. Coombe, E. L. Fraser, R. P. Gaddum, J. D. Hoare, J. C. Kelly, D. T. Richards, S. C. Bisset (Accountant), A. W. L. Turner (Secretary) and by invitation Dr. Roland V. Norris (Director, T.R.I.)

Absent.—The Director of Agriculture, Col. T. G. Jayawardene, V.D. and Mr. D. H. Kotalawala.

1. Notice calling the Meeting was read.

2. The Minutes of the Meeting of the Board of the Tea Research Institute of Ceylon, held on the 7th December, 1935, were confirmed.

3. MEMBERS OF THE BOARD

The Chairman welcomed Mr. R. G. Coombe who had returned from leave and resumed his seat on the Board on the 10th December, 1935, and also Mr. J. C. Kelly who had been nominated by the Ceylon Estates Proprietary Association to act during the absence of Major J. W. Oldfield, C.M.G., O.B.E., M.C.

On the Chairman's suggestion it was decided to record a very hearty vote of thanks to Major Oldfield for the very valuable services he had rendered.

4. COMMITTEES

(*a*) *Allocation of Expenditure Committee.*—Mr. D. T. Richards said that as Mr. Kelly was now on the Board he would like with their permission to resign from this Sub-Committee because Mr. Kelly had a better knowledge of the subject.

Mr. Kelly agreed to serve and the Board accepted Mr. Richards' resignation. The Members of this Sub-Committee are:— The Chairman, T.R.I., Mr. R. P. Gaddum, Mr. J. C. Kelly and the Visiting Agent (Mr. J. W. Ferguson).

(*b*) It was unanimously decided that Mr. J. C. Kelly should serve on the following Sub-Committees during the absence of Major Oldfield :—

(i) Medical Sub-Committee (ii) Finance Sub-Committee and (iii) Administration Sub-Committee.

5. ADMINISTRATION

After careful consideration it was decided that it would be in the best interests of the Institute if all the office work were centred at St. Coombs Estate, and that the change should be made as from the 31st March, 1936.

A. W. L. TURNER,
Secretary.

REVIEW

VERNALIZATION AND PHASIC DEVELOPMENT OF PLANTS*

THE idea of vernalization originated as a result of a new outlook on plant growth and development formulated by the Odessa school of plant physiologists headed by T. D. Lysenko. Until 1930, it was unknown to wider circles of agriculturists, though since that time it has assumed a very prominent place in agricultural literature and thought. The general principles of the theory are now widely familiar. These are roughly that growth and development, far from being identical as has been popularly supposed, are in reality two distinct and separate phenomena. Growth is regarded merely as increase in size and weight and such changes as flowering and reproduction are included under development. According to the new theory either of these two processes may proceed independently of the other, so that we may be faced with the extraordinary case of a plant which comes into flower without having grown or a plant which grows for ever without ever coming into flower! All that it is necessary to do, it would seem, to produce such remarkable behaviour, is to treat the plant in such a way that one of the two processes is favoured to the exclusion of the other. If seeds of winter wheat are germinated in an ice box and subjected to suitable conditions of light, aeration, humidity and other factors, they can be sown in spring and will come into ear at the same time as if they had been sown in the ordinary way in autumn. Hence the term "vernalization," which is a latinized equivalent of the Russian word "Jarovizacija" coined by Lysenko to describe the phenomenon and which strictly means "transformation of winter forms into spring."

The matter was first brought to the attention of English-speaking readers by a bulletin issued in 1933 by the Imperial Bureaux of Plant Genetics. This early bulletin gave a complete outline of the method as it was described in Lysenko's first publications, and consisted mainly in the description of a practical method for the pre-sowing treatment of seed to obtain this accelerated development in a variety of crops. The method was rapidly seen to be of practical importance not merely in Russia but in all parts of the world. In view of the wide interest taken in the subject the

*Vernalization and Phasic Development of Plants. Joint Publication of the Imperial Bureaux of Plants Genetics. Cambridge 1935. Price 10/-.

Imperial Bureaux have continued to collect the literature relating to it. This has assumed such magnitude and the subject has become so much extended in its range that the whole matter has been reviewed afresh in a new and much enlarged bulletin covering some 150 pages.

This new bulletin describes in detail the results of the many experiments that have been carried out on all sorts of crops under every possible condition, both in the Soviet Union and in other countries all over the world. The results of vernalization of over 6,000 varieties of wheat and of 500,000 hectares of vernalized sowings, based on replies to a questionnaire received from 1,056 different Soviet farms, are reported. The results have on the whole been satisfactory when the necessary conditions of technique have been observed and it would seem that the method may now be definitely regarded as a useful agricultural measure in countries where early ripening is a decisive factor in successful cultivation. For instance, spinach, sugar beet and even potatoes have by suitable treatment been grown at Hibiny in the Arctic Circle. Cereals have been induced to ripen a week or more earlier and by this means it has become possible to extend their cultivation to large tracts of country where this has been impossible hitherto because of drought or other unfavourable conditions. The main results of the Russian workers have now been confirmed in most countries where vernalization has been tried. In countries of more normal climatic conditions the method will probably not be of such wide application to the main crops but in the case of salad, vegetable and market garden crops a difference of a few days may prove of tremendous economic importance and a considerable future is foreseen in the application of vernalization to plants of this type. The Russian workers have even claimed to get increased yields from vernalized sowings but there seems to be some difference of opinion on this point and others have observed a depression in yield after vernalization.

At least half the bulletin is devoted to the physiological aspect of the phenomenon of vernalization. Lysenko's original conception has been extended to cover the whole range of plant development, in the form of the theory of Phasic Development. Development, says Lysenko, consists of a series of stages, each of which requires for its completion a definite combination of external conditions. The conditions for one phase may be different from those required for others, temperature being the decisive factor for the first stage and light for the second. Each stage must be completed before the succeeding one can be initiated but once any stage has been completed there is nothing to prevent the progress of the following one, provided the necessary external conditions are forthcoming. The method of vernalization therefore consists in the provision at as early a point in the life of the plant as possible of the requisite conditions for all the developmental stages leading up to reproduction, thus curtailing the long periods of time that normally occur between these successive stages. A freshly germinated seed has been

found to be the most suitable material to work on, as this can be conveniently treated before sowing and then sown in the ordinary way.

Other Soviet botanists, though agreeing with Lysenko's general findings, disagree with many of his conclusions and have put forward theories of their own. The views of these other workers are presented in the bulletin side by side with those of Lysenko in a spirit of pure impartiality. In fact a careful study of this bulletin shews that it has dealt with the available information from all possible points of view, equally generous treatment being given to the practical application of the method in agriculture and horticulture and to its theoretical explanation. It will be of interest to plant physiologists, biochemists, plant breeders, teaching botanists and indeed to anyone concerned with modern trends of botanical and agricultural research. "The rapid development in scientific research is one of the outstanding features of the Twentieth Century," as Sir David Chadwick aptly remarks in his foreword : "Research workers need the earliest possible information of developments affecting their line of study but frequently find themselves baffled by its volume and by linguistic difficulties." To overcome these difficulties the Imperial Agricultural Bureaux were organized in 1929 and the bulletin under review affords an admirable example of how these Bureaux fulfil their function. The large majority of the articles with which the bulletin deals are written in Russian and would have remained entirely unknown to the rest of the world if they had not been made available in the present form. A total of over 200 separate articles are considered and reviewed in detail and large sections of the tabulated results of the authors are reproduced in a review of the work of the whole world on this controversial but entrancing new subject.

[A Note by Dr. J. C. Haigh, Economic Botanist, Department of Agriculture, Ceylon, on the above review is given herewith—Ed. T. A.]

This excellent summary has been written by the compilers of the bulletin, but it gives a very inadequate idea of the amount of work that must have been necessary to produce these 150 pages of valuable information. Truly the Bureaux may claim to be fulfilling their function.

It is only to be expected that Soviet Russia, the birth-place of the idea of vernalization, should provide the greater part of the evidence in its support (the accounts of the researches carried out in the Soviet Union occupy 112 pages) ; at the same time one is impressed, on reading this bulletin and a previous one issued by the Bureaux,* by the tremendous output of scientific work from Russia, and many people consider that in the field of agricultural research, she leads the world at the present time.

The results of the Russian workers all demonstrate the positive effects of vernalization, although agreement has not been reached on the actual

* Plant Breeding in the Soviet Union—Joint Publication of the Imperial Bureaux of Plant Genetics 1933.

mechanism by which the effect is produced. Results from other countries are not so unanimous (the possibility of incorrect application of the technique must not be overlooked), but the general conclusion appears to be that the practical application of vernalization will be of greatest value with "long day" (or "temperature") plants, in making possible their cultivation in areas where the growing season would otherwise be too short. There is also the possibility that suitable treatment may allow of the cultivation of "short day" plants in temperate areas.

The practical value of vernalization to tropical countries is doubtful. The experiments carried out in Ceylon have been fully described in this journal, and indicate that the effect of pretreatment of seed is too small to be of practical value (although an effect of the same magnitude may be of great value in more northern latitudes); the bulletin gives a few reports from other tropical countries, but none is particularly optimistic. Nevertheless, there is evidence of truth of Lysenko's hypothesis of the independence of growth and development. The possibility of "a plant which grows for ever without ever coming into flower" has been demonstrated in paddy; plants sown out of season, and which should normally have flowered in 5 months, have grown for a full year without any sign of flower spikes. On the other hand, other seed of the same variety, sown 6 months later, has matured in $4\frac{1}{2}$ months instead of the normal $6\frac{1}{2}$, indicating that here development has been relatively more rapid than growth. It is not clear how these deviations from normal performance, that can be produced merely by changing the sowing date, are explained on the theories put forward by Lysenko and his fellow-workers. Climatic conditions at Peradeniya are uniform to such an extent that deviations from the annual mean are not significant in any month for statistics such as mean a number of hours of sunshine, mean length of day or mean monthly temperature. Since length of day and temperature are said to be the factors controlling changes in development, it does not appear why such changes should take place as a result of a change of sowing date in so uniform an environment.

ANIMAL DISEASE RETURN FOR THE MONTH ENDED FEBRUARY, 1936.

Province, &c.	Disease	No. of Cases up to date since Jan. 1st, 193 .	Fresh Cases	Recoveries	Deaths	Balance Ill	No. Shot
Western	Rinderpest	..	..	..	..	..	..
	Foot-and-mouth disease	2	2	2	..	..	..
	Anthrax	..	..	..	..	..	..
	Rabies (Dogs)	9	4	..	..	..	9
Colombo Municipality	Rinderpest	..	..	..	..	..	..
	Foot-and-mouth disease	..	..	..	..	..	..
	Anthrax	..	..	..	..	..	..
	Rabies	11	5	..	11	..	..
Cattle Quarantine Station	Rinderpest	..	..	..	..	..	..
	Foot-and-mouth disease	..	..	..	..	..	..
	Anthrax	6	4	..	6	..	..
Central	Rinderpest	..	..	..	..	..	..
	Foot-and-mouth disease	326	146	183	3	140	..
	Anthrax	..	..	..	..	..	..
Southern	Rinderpest	FREE					
	Foot-and-mouth disease						
	Anthrax						
Northern	Rinderpest	..	..	..	..	..	..
	Foot-and-mouth disease	49	49	34	..	15	..
	Anthrax	..	..	..	..	..	..
	Haemorrhagic Septicaemia	30	30	10	15	5	..
Eastern	Rinderpest	FREE					
	Foot-and-mouth disease						
	Anthrax						
North-Western	Rinderpest	..	..	..	..	..	..
	Foot-and-mouth disease	109	53	85	1	23	..
	Anthrax	..	..	..	..	..	..
	Rabies (Dogs)	9	5	..	1	..	8
North-Central	Rinderpest	..	..	..	..	..	..
	Foot-and-mouth disease	540	76	514	..	26	..
	Anthrax	..	..	..	..	..	..
Uva	Rinderpest	..	..	..	..	..	..
	Foot-and-mouth disease	..	..	..	..	..	..
	Anthrax	..	..	..	..	..	..
	Rabies (Dogs)	2	..	..	1	..	1
Sabaragamuwa	Rinderpest	FREE					
	Foot-and-mouth disease						
	Anthrax						

Government Veterinary Department,
Peradeniya, 12th March, 1936.

M. CRAWFORD,
Government Veterinary Surgeon

METEOROLOGICAL REPORT—FEBRUARY, 1936

Station	Temperature				Humidity		Amount of Cloud	Rainfall		
	Mean Maximum	Difference from Average	Mean Minimum	Difference from Average	Day	Night (from Minimum)		Amount	No. of Rainy Days	Difference from Average
	°	°	°	°	%	%		Ins.		Ins.
Colombo ..	86·4	−0·3	73·1	+1·5	68	88	4·6	4·07	10	+ 1·87
Puttalam ..	88·3	+0·3	71·8	+2·2	71	95	2·6	0·38	4	− 0·69
Mannar ..	87·1	+0·3	75·0	+1·6	74	88	3·2	1·34	2	− 0·39
Jaffna ..	87·2	+1·7	75·9	+4·3	70	86	3·0	0·86	6	− 0·30
Trincomalee ..	84·1	+1·5	76·0	+0·3	74	84	4·2	3·96	7	+ 1·92
Batticaloa ..	84·4	+1·7	74·7	+1·3	80	93	4·3	3·86	7	+ 1·18
Hambantota ..	86·6	+0·8	74·0	+1·6	74	93	3·0	0·53	4	− 0·51
Galle ..	85·4	0	74·4	+1·2	75	90	3·6	4·46	10	+ 1·47
Ratnapura ..	90·5	−1·1	72·1	+1·2	72	93	3·9	10·56	17	+ 6·12
Anuradhapura ..	87·8	+1·1	71·9	+2·9	68	95	4·0	2·73	9	+ 1·24
Kurunegala ..	90·8	+1·4	70·9	+1·7	63	93	3·7	4·17	3	+ 2·48
Kandy .	87·7	+2·1	68·4	+1·6	62	90	3·2	2·73	5	+ 0·93
Badulla ..	81·1	+2·5	64·8	+2·1	74	97	4·4	5·04	9	+ 2·55
Diyatalawa .	75·8	+1·1	58·2	+2·3	70	88	4·8	3·02	13	+ 1·22
Hakgala ..	71·7	+2·5	52·3	+2·6	76	91	5·8	2·22	13	− 1·20
Nuwara Eliya ..	70·9	+1·2	46·0	+2·3	66	93	4·4	1·93	7	+ 0·22

February rainfall was on the whole above normal. Excesses and deficits were somewhat irregularly grouped. The extreme north of the Island was generally in deficit, as were also the western coastal districts from Jaffna down to Chilaw. Other districts reporting deficits were those between Colombo and Kurunegala, and those in the extreme south-east of the Island, while many stations up-country were also below average. Excess was most marked in the foothills adjoining the main hill-masses, in the adjoining low-country, and in the districts between Matara and Deniyaya.

The highest monthly totals reported were 20·85 inches at Hendon, and 20·17 inches at Auningkanda. Very few stations reported no rain at all during the month, but a large number, mainly in the extreme north and in the north-west, reported totals of less than 2 inches.

Only six daily falls of 5 inches or over were reported, all between the 6th and 8th. The highest was 6·90 inches on the 7th, at Sigiriya.

During the first week of February rain continued fairly widespread, and moderately heavy in places, as the result of local thunderstorms. It then fell off, and was now mainly confined to the neighbourhood of the hills. From the 15th to the 22nd very little rain was reported anywhere. The rainfall then again increased, as the result of local thunderstorms, and was widespread and fairly heavy on the 25th and 26th. At the end of the month a dry spell set in, with low night temperatures, particularly up-country.

Mean monthly temperatures were generally above normal, particularly night temperatures. Relative humidity was above normal, while clouding was below normal. Barometric pressures were below normal in the north, and above in the south, so that the usual northerly gradients were weaker than usual. Wind strength was on the whole about normal, except at Jaffna, where it was above average. Wind directions were somewhat irregular, but were on the whole easterly.

There were three reports of hail-storms during the month; on the 1st, at Andiyamalatenna, near Adam's Peak; on the 13th, at Dabar Estate; and on the 25th, at Holmwood Estate.

H. JAMESON,
Superintendent Observatory.